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THE TEACHING OF ENGLISH IN A SCIENTIFIC SCHOOL

THE teacher of English in a scientific school faces in many ways a special problem. In a place where exact sciences are fundamental, he teaches an art which must often appeal to standards of taste. He finds always among his pupils a number who are at the start unsympathetic. Yet his subject is undoubtedly important. Aside from its practical value in training men in bearing and address, English composition may be made the basis of logical cultivation of the thinking powers, and the means of awakening in the mind the love of broader scholarship. On these accounts, if those interested in scientific education ask themselves how the time devoted to teaching English in scientific courses may best be employed, they are attacking a question by no means unimportant. In an attempt to throw some light on this question the present paper undertakes to deal with the broader aspects of the work in English composition as the writer has observed it during the last eight or nine years at the Massachusetts Institute of Technology.

Undergraduate instruction at the Institute of Technology is divided, as may be known, among thirteen prescribed courses of scientific and engineering studies, each of four years' duration. Without attempting to be precise, it may be stated roughly that the first two years are given up to studies which are regarded partly, or even mainly, as a means of general education. These subjects range from mechanical drawing, through elementary physics and chemistry, to history and economics. Some of them, like history, are purely educa-

tional; others, like drawing, have a distinct bearing on later professional work, but still are taught in the theoretical spirit, and with the purpose of developing power. To the latter class may be said to belong the subject of English composition. It is intended to furnish a tool for business and professional life; but at the same time it should serve to broaden the student's interests, to stimulate his power of observation, and to make him more alive to his inner mental process and better able to control it.

The time devoted to this subject is confined to two terms of fifteen weeks each during the first year of the four-year course. In the first term there are two class-room hours, and two hours of preparation each week. In the second term only half this time is allowed, and the division between class-room hours and preparation is left somewhat to the option of the instructor. When theme work is being assigned it is usual to consider two hours—the preparation period for the week—sufficient for the production of a theme of about three hundred words.

The work of instruction is carried on during the present year by a teaching force of eight persons. No detailed account of class-room methods is here intended, or would, indeed, be possible. The work has always been treated, by those responsible for its control, with a breadth and liberality which leave all possible scope for individual ingenuity in the teacher and for the adoption of new methods. To the writer, accustomed for some years to this large measure of freedom, it is inconceivable that work so dependent for its success on inspiration could be accomplished under any other system. At all events it is the happy privilege of those who teach English at the institute to regulate their own work, in all except its essential policy, and to adapt it, in so far as

their various capacities allow, to their own powers and to the needs of the class. Under these conditions I must necessarily confine my account to a general view; and it is my purpose accordingly to discuss the underlying principles of this teaching, in so far as they seem likely to bear on the general problem of engineering education.

Students enter the institute on the basis of a high-school or college preparatory training. Therefore, as far as English is concerned, they come to us fresh from the study of the requirements adopted by the Commission of Colleges in New England. They have been reading selected works from the English classics, discussing their style and construction, writing appreciative essays about the characters which occur in them, or perhaps attempting "daily themes" on subjects of a supposedly more personal nature. In lieu of other models, however, we may fairly suppose that the style in this written work has been, consciously or unconsciously, molded after that of the classics studied. The works prescribed are, I believe admittedly, neither the most absorbing nor the most noble in the language. I doubt if they are such as the teacher himself would choose as the preferred companions of his idle moments; but rather they illustrate the general truth that we advise children and the young to undertake many tasks from which we ourselves should shrink. Of necessity, then, the college requirements in English are in many cases administered by the secondary school teacher as a medicine; and, in view of the pressure of preparatory work, in maximum doses. As a result of these conditions the engineering student enters the institute with strongly conceived notions about the study of English. He does not, as a rule, come of a "literary" family. Outside school requirements, his reading has been drawn chiefly from the *Scientific American* and perhaps the newspapers. In

school he has read "literature." Literature, therefore, is, to his mind, like his school reading, either dry, silly or incomprehensible. By the same token English composition, the making of more literature, is an art in which he sees no practical value. For teachers, newspaper men and clergymen the thing may be well enough; but it requires a special gift of phrase-making which he feels rather glad to acknowledge that he lacks.

The teacher who successfully combats this prejudice has accomplished a delicate task in persuasion. He must work toward this end along three lines: he must give the incoherent and undeveloped mind respect for its own productions; he must remove, as far as may be, the embarrassment of his own too critical presence; and, finally, he must attempt to show, as no rules of English composition derived from the study of models of literature ever can show, a rational aim in writing and an easily attainable attitude of mind which will lead to success. This is essentially the problem of teaching English composition at the Institute of Technology.

In attempting to solve this problem it is essential, above all things and at the very start, to give the student respect for his new attitude as author and, at least in prospect, for his new product. With this aim in view the student is at the outset usually requested to select his own subjects for written work. His attention is called to the fact that success can come only with topics which he cares about and knows. At the beginning of the first term, and again later, as need arises, he hands in a short list of subjects on which he prefers to write. These are tested, in the first instance, only as to the degree of knowledge and personal interest behind them. In a large school like the institute, which draws its students from all parts of the world, and in some cases from men of business and professional

experience, the subjects present considerable range and some novelty. There is first the immature school boy, graduated from a neighboring high school, who has seldom left his native town. He has his favorite sports to tell of, hunting and fishing trips, perhaps an occasional criticism of high-school methods or of institute life. Beside him is the student who has traveled or lived abroad, or in distant parts of the United States, and is full of information as to unfamiliar methods of life and work. Finally comes the young man of professional experience, who is ready and glad, if he can find an instructor or a fellow student well enough informed to follow him, to expound deep matters, like the theory of injectors, or fire-proof electric wiring. Common to all these writers, and more promising than other subjects, are those which relate to business methods or manufacturing processes engaged in or observed—"The Duties of a Stage Hand," "The Working of a Small Steamer," "Surveying with a Party in Pennsylvania." Of the students I have met in the last five years, only about two per cent. failed to respond to this method and declared themselves utterly devoid of ideas; the rest were rather easily supplied with congenial subjects, and started on work which from the beginning they could take seriously. It at once presented itself to the mind as worthy of respect, because entirely within the limits of their powers of expression, and likely to be valuable to the reader after it was done.

The subjects thus presented are, when possible, neostyle-copied and handed about the class. At all events it is essential that the students should have access to the list. This makes for the class work the hour of promise—nature putting forth her power "about the opening of the flower." The most possible should be made of it. It remains only to shield the actual product

from too high a standard of criticism, and to provide each author, if possible, with sympathetic and intelligent readers. The class at large is no fitting audience. It demands, or seems to demand, too much, and frightens all but the more experienced or callous. Then again its mood is perhaps a little disingenuous. In attempting to hit its apparent taste one degenerates inevitably into smartness and after-dinner jesting. Individual critics chosen from among the students give better service. This plan may conveniently be followed if it is possible to neostyle-copy the lists of subjects. In that case each student explains briefly his proposed subjects, their general scope, method of treatment and point. Those who are interested in a particular subject signify their willingness to read the work, one of them is assigned as a critic, is later consulted by the author, and finally takes the instructor's place in giving a written criticism and correction of the finished theme.

This plan has some large theoretical advantages. It turns the youthful author over to critics of approximately his own age and experience. It relieves the teacher of some drudgery, and spares him the odium of fault-finding. Still, it should not be followed exclusively. One's fellow students are severe critics, but not usually sympathetic. Some will be misled by the titles, however fully explained, and find, perhaps, that they have more information than the author himself, or that they are not interested in the subject as he feels competent to treat it. Others will neglect to confer with the critics. This is perhaps the main danger. In the matter of instruction, both religious and secular, most of us think shame to adopt too serious an attitude, and even the boy who takes his studies most to heart will sometimes shrink from being known to do so. The whole question has been well handled by Mr. R.

G. Valentine, in a paper "On Criticism of Themes by Students," in the *Technology Review*, Vol. 4, p. 459. Mr. Valentine there discusses the advantages of the plan as adopted in his own institute classes at the time. Whatever drawbacks may accompany them, these advantages undoubtedly exist. A considerable portion of every student's work should unquestionably be read by his fellows, and, in classes sufficiently small for constant supervision, perhaps the whole. Such criticism, if taken seriously, soon removes the impression that the teacher's fault-finding is professional; and it takes composition into the field where it belongs—the field of practical dealing between man and man.

This relation between man and man, this sympathy on which all successful writing is based, must in the end, of course, depend upon the human quality of the teacher himself. He must learn, in a thousand ways, not to take up his position where he shuts out the light. The distance between an undergraduate and a man of over thirty, especially when the man is burdened with the moral awfulness of the teaching profession, is in itself considerable. With a little lack of sympathy, a little giving way to cheap sarcasm, the gap may become so wide as effectually to stop all communication. The student has at the start no notion that his teacher is human; and if in the end the teacher himself forgets that he is so, it will be well to dismiss the class. The wise teacher, however, emphasizes points of contact, as he would in any other social relation. He resolves to be interested, instructed or amused. He looks upon the work handed him, not as an exercise which may contain interesting errors or violations of principles, but as an expression of character, however immature, and of attainments, however limited, such as he will not find precisely duplicated in any other person. He maintains

a liberal and a cordial spirit in his criticisms. For the moment he sacrifices the ends of teaching for those of inspiration. If there be any virtue and if there be any praise, he looks on these things; and for his reward the reading of themes, which his friends all think must be deadly boredom, rises to the importance of an end in itself. It introduces him to a circle of congenial spirits, each furnishing for his entertainment the best that the mental stores can supply.

In the mass of material which the teacher reads—not of course without hours of discouragement—one element of interest is never lacking. He sees, at least, the working out of his own theories, and he watches a growth, however slow, implanted and tended by his own hand. For the rest, though his sympathy is sometimes an ideal state, much of what he reads would be interesting in any connection. In his classes he is constantly meeting men who, aside from spelling and the principles of composition, are better informed than he. These men he encourages to write of what they know. In the past five years I remember many pieces of work that could hardly have interested me more if they had been literary ventures of my own. One man, not so far removed from boyhood as to need a razor, wrote for me on the social life of boys, and it happened that his conclusions, largely illustrated from his own experience, were not unlike my own. I suppose I shall never read in print so frank and faithful an account of that period which usually goes unrecorded. I had a long paper on Colorado forest reserves and timber protection, from the son of a large timber owner. A boy who had been brought up abroad wrote a series of essays on German school life and customs. The thing which perhaps gave me most enjoyment in watching its growth was a fairly complete account of the Fore River

works at Quincy, Mass. The author was engaged on this the better part of a term, partly in interviewing men and collecting material. I watched his work at every step. In the end he read large extracts to the class and showed the photographs which he had taken. In the public reading—and not till then—it dawned upon him that his style was rough, and, whereas at the opening of the term he had no notion of turning a sentence, he became in the end, without a hitch in the natural development of his mind, his own critic of style. These men were interesting and interested because met on their own ground. I might, if it had seemed expedient, have assigned them subjects in treating which they would have bored both themselves and me to extinction; but on the other hand I should dislike excessively to handle many subjects that they, if they had the upper hand, might assign to me.

It is not so hard, then, for the teacher to be sympathetic; but sympathetic he must be at any cost. To secure that end he must in most cases criticize orally, not in writing. The complete explanation in writing of even a minor fault will often require enough red ink to discourage the elect; and then, ten to one, the fault is no fault at all, but the result of some text-book principle, too narrowly applied. Oral criticism is more expressive, and at the same time more modest. It assumes that all is fundamentally right, ascertains the meaning by questions, conceals that usually large part of the difficulty which arises from the critic's own stupidity, and suggests a way out of the remaining trouble. All this is no chastisement, but a very human and urbane process; it is merely what occurs every day when two people talk on a congenial subject and try to arrive at an understanding.

In the substance of this criticism as well there is a corresponding tempering of the

wind. The criticism of details is for a time kept in the background. The instructor pretends to believe, what no one really believes in these days, that the secondary schools have found time to teach grammar, spelling and punctuation. Faults in these may be weeded out later, but for the present it is remarkably sound doctrine that to pull out the tares destroys the wheat. There is an old moral story of a merchant who, wishing to test the quality of two boys who had applied for work, gave each the half of a garret to be set in order. One, the hero of the tale, sorted all the rubbish with infinite pains, brads and tacks, crooked and straight. The other, with a fine impatience, swept things into heaps and threw them from the window. The second lost the place, but I confess he has my sympathy; he seems to me to have had a juster notion of relative values than the other. At all events his temper of mind is like that of the average student. No young man of promise will work conscientiously at correcting minor errors in work which is confessedly rubbish. He must seek first the task in which he can take a vital interest, and then all these things shall be added unto him.

Greater closeness of relation with the instructor, as well as the habit of writing for classmates, will both tend to bring out clearly the central problem of writing—the adaptation of work to a particular audience. Even when themes are written directly for the instructor, the attempt is usually made, by preliminary conferences with the student, to impress upon him that he is not writing for a general court of appeal, but for an individual mind, with definite prejudices, ascertainable limits of knowledge, and individuality of point of view. In teaching the writing of essays in literary criticism or of sonnets, the instructor may well set up to be the embodiment of the laws of taste and good

use. If he is accused of urging as authoritative opinions which ought rather to be regarded as personal, he can hide behind a multitude of admitted classical instances where it is very hard indeed to find him. In attempting, on the other hand, to teach an engineering student straightforward English prose for business purposes, it is necessary to assume a somewhat simpler attitude. One says, not "This is bad," but "I dislike it"; not "Your expression lacks force," but "You have not brought your argument home to me, and thus you have failed; for your whole object was to produce an effect on my mind." The student who sees his work treated from this point of view begins to find the problem of writing simplified. Composition for him takes on the look of a practical art, for it is after all only one department of the great business for which he is being educated, the business of dealing with men. Before it had seemed a mystery, like the concoction of some foreign dish. A compound of so much force, so much unity, and the rest, would make a dainty to tickle the teacher's palate. One had first to get together the somewhat mysterious ingredients—by no means an easy task; and in the end one was left wondering whether the teacher had not acquired a perverted taste. Instead of these unnatural relations, the pupil who has been taught to write directly for some classmate or for his teacher finds himself in a simplified position where he knows definitely what is expected of him, can himself measure the degree of his success or failure, and may keep within a safe distance of the manner and the matter to which his daily life and his conversations with his fellows have accustomed him.

As the term progresses and men get the notion that their writing is to serve some useful end, all sorts of other plans may be tried. They may even be assigned subjects, of a reasonable sort. At some time during

the term use is made of exercises bearing on the collection of facts and on observation, to the end that the student may in a degree learn how to observe, or at least to realize, why he has hitherto observed so little. To this end the class perhaps goes with the instructor to look at some relatively simple object, as the façade of a building. The natural sub-divisions are first discussed, and the order in which they may best be taken up; then the lines of observation essential to be followed in rendering each of these parts. After perhaps twenty minutes of this work, the men return with their notes to the class-room and write the report. Following this preliminary exercise under the eye of an instructor, more assignments are given out, of details of buildings, and features of natural or artificial interest about Boston, all being subjects on which the instructor has taken careful notes. The lesson of thorough and systematic observation thus begun is enforced by the assignment of subjects of a slightly different nature, from life, models or photographic enlargements. In all similar assignments for written work, the attempt is made to treat definite subjects, so that the results can be tested at any time, and criticized wholly, by an appeal to facts. Later in the year a more ambitious report is often attempted, involving not only natural but logical subdivisions, say on a neighborhood as a place of residence, or on a preparatory school. The subject is made general, but the student chooses that particular place or school with regard to which he has the most information. To help him in gaining what might be called self-consciousness, an articulate recognition of the ideas which are lying unrealized in his mind, he is given a list, as complete as it can be made, of the observations which would be pertinent, for instance the things necessary to be looked out for in selecting a place of residence.

It is usual in this work to leave the determination of the scope and mode of treatment to the student; and the result in most cases is a long, detailed, relatively mature, and often admirably arranged report, of from ten to fifteen pages of theme paper—the ordinary letter sheet.

These reports, thus constructed, are essentially like the engineering report of later years, and in this connection it is usual, when time permits, to study at least one engineering report, with an analysis of its headings, as showing the divisions of the subject, and the sort of observations which the engineer has thought it advisable to make under each head.

Thus there has been in the English instruction at the institute a conscious and, I believe, a conscientious effort to meet the conditions imposed by the needs of a technical school. The teaching differs fundamentally, both in spirit and in methods, from the instruction in English composition given in academic colleges. I myself was put through all the training offered in this line by one of the foremost eastern colleges; yet there were certain ideas which seem to me fundamental in the training of engineers that, so far as I can remember, were never hinted to me. Part of the explanation for this is doubtless drawn from my undergraduate stupidity, but not all; for I did absorb several strong impressions more or less opposed to these. It never occurred to me that fact is the background of all writing; or that a man has no business to write about matters of which he is ignorant; or that the substance is primary to the form; or that writing, like speech, is for the sole purpose of producing an effect upon some other mind and that all its laws must be derived from the consciousness of this fundamental principle.

The great present needs of such teaching

of English composition as I have described are two. The first is closer contact with professional departments. Such contact has already been secured to some extent in the higher years, where professional reports are reviewed by members of the English department. This, however, is likely to resolve itself into a mere correction of faults in the technique of expression. What is needed rather is discussion and reports in which from the outset the teacher of engineering and the teacher of English shall cooperate; which shall be both conceived and carried out with the purpose not only of securing accuracy in details of fact, but also of studying the theories of thought and of expression which underlie such work. For instance, in connection with the reports spoken of above, it has for some time been a dream, unrealized as yet on account of tabular view adjustments and other practical difficulties, that first-year students might be taken in small sections, in the company of an instructor from an engineering department and another from the department of English, to study and report on some simple assignment along the lines of their chosen profession. The experiment, I believe, would be worth all the trouble of arrangement, and would do much in stimulating their powers of observation and in teaching them that the mastery of an English style is no ornamental acquisition, but the means of expressing yourself, your attainments and your facts, so as to become a moving force in the world.

The second need of this teaching is that of teachers. In other subjects, teachers—the good ones—are said to be born, not made. The ideal teacher of composition could hardly be born, for the limitations of human nature preclude him. To criticize all thought—the substance of it, from which alone the form depends—to sympathize with every point of view, to win the

confidence of every type of mind—these tasks require some genuine magnanimity of soul. No man can fully meet so large a requirement, yet here and there are found persons not ill adapted on one side or another for the task. Nothing can come amiss—scraps of general information, breadth of interest, the power of drawing out other people's ideas, above all warmth of heart. Meanwhile with whatever equipment, lucky if with a trace of some necessary quality, one does one's best. It is at least something to have conceived the sort of man one ought to be.

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*THE CONDITIONS AFFECTING CHEMISTRY
IN NEW YORK¹*

IN assuming the chair, I am confident that the coming year will be one of great progress in our section's history, not through any merit of its officers, but through the ever-increasing spirit of co-operation among the members, and the rapid strides which research and industry are making in this country. You will hear reports, this evening, of two important general meetings that interested our membership, that of our own society at Detroit and that of the International Congress of Applied Chemistry at London. In both, members of this section bore a worthy share, and it is a gratifying tribute to American progress in science and industry, that the International Congress chose America for its next meeting-place. It is not only the foreigner who lands at Ellis Island that deems America synonymous with New York, and the members of this section must be prepared to do their full duty, during the next three years, in order that our foreign brethren may carry back

¹ Address of the chairman of the New York Section of the American Chemical Society, delivered October 8, 1909.

from their visit a crystalline rather than a colloidal vision of chemistry in America.

And so, gentlemen, I have preferred to devote the minutes which custom permits your chairman to employ in airing his personal views, to a survey of the conditions affecting chemistry in New York, rather than to the presentation of some debatable scientific ideas, as I had originally intended. The choice of the more subjective topic is rendered more appropriate by the fact that this meeting is to be followed by a session of the Chemists' Club, called for the purpose of settling a question vitally affecting the interests of New York chemists.

Eighteen years ago, when the men who had carried the American Chemical Society through so many vicissitudes organized this section, in order that the general society might become a truly national one, I had the honor, rather than the duty, of being the first local secretary. The meetings were so poorly attended, the original papers so scarce, and the general business so unimportant, that no heavy work developed upon its officers. We met in the chapel of the old university building, where Professor Hall and I had our primitive laboratories, out of which we carved, with some difficulty, shelf-room for the fragmentary society library. When we felt in need of a little variety, we sat in Professor Chandler's lecture-room in 49th Street and listened to the passing trains; or in East 23d Street, peered at the chairman ensconced behind batteries of Professor Doremus's bell-jars and air-pumps. An attendance of forty members, I believe, was a record-breaking event.

I need hardly expatiate upon the wonderful changes that have been wrought since 1891. Our three colleges have moved far up-town, and the splendid Havemeyer Laboratories of Columbia and New York University, and the beautiful new chem-

istry building on St. Nicholas Terrace, make us glad to miss the dingy and crowded places where chemistry was taught an academic generation ago. Our own section and kindred societies have been meeting in this hall of the Chemists' Club for the past ten seasons, and no one can estimate what share a fixed and commodious meeting-place has borne in the marvelous increase in membership and attendance. The other important factor is, of course, the growth of chemical industry in this vicinity.

While we can, therefore, congratulate ourselves upon the great strides that have been made, during the past two decades, it behooves us to inquire whether there are not still some drawbacks to our progress, not by way of carping criticism, but for the purpose of seeking such effective remedies that future progress may be made absolutely certain.

For obvious reasons, we need not ask whether the internal conditions in the chemical factories are satisfactory; since there the managers must know that their success depends upon the scientific abilities of their chemists. It is doubtful whether the same can be said of the establishments which employ a chemist or two to apply specific tests; and it is certain that there are still many factories which conduct, by rule of thumb, operations that should be continually controlled by scientific tests, if shameful waste is to be avoided.

The American people are but slowly learning the importance of the educated banker and the expert accountant alongside the brilliant financier and the bold speculator; similarly, while they acclaim the clever inventor and the skilful engineer, they have yet to recognize the worth of that expert accountant of material economy, the industrial chemist. Quite aside, therefore, from any wish for greater profits to our associates who are gaining their daily bread as commercial or analytical chemists, pa-

triotic motives lead us to the earnest hope that closer watch upon the economy of production may bring about that conservation of natural resources of which the politicians prate, but for which the chemist works. How, then, can the status of the independent commercial chemist be raised in our city? By giving him a central rallying-point; a home that proves to the layman that his is a skilled profession, not a mere job-hunting trade; a place where the manufacturer or merchant can find the man he wants without a rambling search through the city directory. Doubtless, some of our colleagues are so well known, that all the business comes to them which they can handle. But the many additional independent chemists, whom our commercial situation demands, can only establish themselves if they can secure proper laboratory facilities, without hiring attics in tumble-down rookeries.

Every year scores of New Yorkers graduate in chemistry from our local institutions and return from years of protracted study in other American and European institutions. They are enthusiastic for research; in completing their theses they have laid aside definite ideas for subsequent experimentation; but they have no laboratory. While waiting to hear from the teachers' agency where they have registered, while carrying on desultory correspondence with manufacturers who *may* give them a chance, they do not venture upon expenditure of time and money to fit out a private laboratory, which they may be called upon to quit any minute upon the appearance of that desired appointment. Often necessity or tedium will cause them to accept temporary work of an entirely different character and indefinitely postpone the execution of the experiments which they had mapped out. Who will estimate the loss of scientific momentum, the economic and intellectual waste, which this lack of labo-

ratory facilities for the graduate inflicts upon New York, as compared with Berlin, Vienna, Paris and London? Either our universities and colleges, or private enterprise, should provide temporary desk-room for the independent research chemist.

So much for the purely practical side of our question? How about the opportunities for presenting the results of investigation? We all appreciate the excellence of the three chemical journals published by our own society, as well as that of the Society of Chemical Industry, and we may say that these, together with the independently conducted periodicals, enable everybody to obtain a hearing; but it does seem to me that the cost of subscribing to all of these journals is excessive, and that much unnecessary expense is incurred through duplication of administrative efforts, as well as through duplication of abstracts, etc. This, of course, is a problem with which we, as a local section, are not directly called upon to deal; nevertheless, it is proper to call the attention of those who are interested in the management of chemical societies in America to the fact that membership alone in the various chemical organizations of New York costs upward of \$50 per year, and that it would be but fair to so arrange matters that the total cost would be reduced by a sort of clubbing arrangement, proportionately to the number of societies to which a member belongs. It seems to me, however, that in one particular point we are at a distinct disadvantage as compared with the foreign chemists: the frequency of regular meetings at which papers can be presented for the purpose of securing priority of publication. Would it not be possible for our various local sections, including the Chemical Section of the New York Academy of Sciences, to arrange the dates of their meetings conjointly in such a way that a meeting would occur once a week during

nine months, and once a month during the summer, thus securing for the New York chemist the same opportunities for the early presentation of a scientific discovery that are possessed by his brethren in European centers? There is, of course, another remedy which appeals to me, though I do not express it with any degree of urgency; namely, the consolidation of all local sections into a single organization which would affiliate its members automatically with all the national bodies now in existence, and would turn over the scientific material of its meetings to those journals for which it seemed most suited. As a matter of fact, glancing over the annual lists of our various local organizations, I find a remarkable interchangeability of officers, and can hardly imagine that the interests of their memberships can be very far apart if the chairman of the New York Section of the American Chemical Society in one year is the next year expected to guide the fortunes of the New York Section of the Electrochemical Society, or of the Society of Chemical Industry. If this were done and we could then exert our influence upon the various general societies to avoid duplication of work, by issuing their chemical abstracts jointly, the strain on the purses as well as the shelves of American chemists would be greatly relieved.

There is still another point, however, in which the American chemist is at a great disadvantage as compared with the European: the ease of securing material for his research and of comparing his results with those of others. In Europe, especially in Germany, research is never seriously delayed by lack of a needed preparation, whereas none of our supply houses carry a full stock of chemicals. To obtain a single gram of some particular substance, needed for a few preliminary tests, frequently causes weeks of delay, as well as the disproportionate custom house and brokerage ex-

penses involved in the importation of small quantities. Besides, owing to the better centralization of scientific laboratories in Europe, and the existence in each case of a fairly complete set of specimens, accumulated in the researches of large numbers of academic investigators, it is comparatively easy to obtain by correspondence research material or typical specimens for comparison. In this country, on the other hand, laboratories are scattered throughout the numerous colleges and universities, and there are no established rules by which specimens must be deposited with the laboratory. In smaller laboratories, especially, the chances of preservation after the departure of the investigator are not very good. It would be, consequently, very much more difficult to obtain such specimens here. I would suggest, therefore, that a chemical museum be established in New York, to perform for the American chemists the functions that the Smithsonian Institution so admirably carries on for the benefit of American naturalists. This museum would not attempt to be a popular show-place, but would embody, in the first place, as complete a collection as possible of chemically pure materials of the rarer kinds, so as to supplement, but not in any manner compete with, the stock of commercial supply-houses. Any scientific investigator would be entitled to borrow or purchase material required for immediate experimentation, and all used articles would be replaced as quickly as possible.

In the second place, it would be the depository for specimens of new substances obtained in American research. Every chemist would be invited to send to the museum a small quantity of each substance newly prepared by him, not, indeed, as an evidence of the good faith of his investigation, but, rather, to enable future workers to obtain such material, either for

comparison, or for further experimentation with the least possible delay. Many substances that are now carried away from universities by students who subsequently abandon chemical research, or which belong to the families of deceased chemists who do not know what to do with them, would thereby be rescued from oblivion, and might ultimately become of the greatest value for a special purpose.

Thirdly, this museum would invite chemical manufacturers to send standard samples of their products, and thereby facilitate the commercial relations between consumer and manufacturer.

To such a museum there could be attached a competent staff of workers for the preparation of materials not otherwise available. In the analysis of samples submitted as official standards, we should have the beginning of that Chemische Reichsanstalt which is now the chief object to which German chemists are directing their attention.

The past twenty years have seen the construction of innumerable teaching laboratories in our vicinity. They have seen an undreamt of development and growth of chemical industry, and, above all, they have seen the coming together of the scattered chemists into a large and powerful society. Now is the time when we should make every effort to direct these forces that we have marshaled toward the attainment of definite objects, and coordinate all our enterprises in those directions that will make for the improvement of the intellectual as well as the material conditions of our beloved city.

MORRIS LOEB

RARE BIRDS IN THE NEW YORK
ZOOLOGICAL PARK

It may be of interest to record the fact that in the collection of living birds in the New York Zoological Park, there are at present an

unusual number of rare species of especial interest to students of evolution. Many are representatives of isolated families or even orders and the majority are neotropical in habitat.

The family Ciconiidae or true storks are represented in the new world by only three species, all of which are now living in the Zoological Park.

The Maguari stork, *Euxenura maguari* (Gmel.), is represented by two specimens, noteworthy as paralleling closely the European white stork, *Ciconia ciconia* in color, but excelling it in size.

The other two American storks are the jabiru, *Mycteria americana* Linn., and wood ibis, *Tantalus loculator* Linn. It is better even for technical purposes to call these by their vulgar than their scientific names, as our over-zealous systematists have recently deftly exchanged their Latin cognomens. Until these new radical changes are approved by some international board, it seems better to use the world-wide *Tantalus* (wood ibis) and *Mycteria* (jabiru).

The former is a common bird always on exhibition, but the jabiru is much rarer, and the splendid individual now in the park is only the second one which we have been able to obtain.

The genus *Chauna* of the order Palamedeiformes is complete, both species of screamer, the black-necked, *C. chavaria* (Linn.), and the crested, *C. cristata* (Swains.), being in the collection.

But the most significant series is of the so-called suborders of Gruiformes or crane-like birds. Four out of the six suborders are represented; the Arami by the limpkin, *Aramus giganteus* (Bonap.); Eurypyga by the sun-bittern, *Eurypyga helias* (Pall.); Psophiæ by the common, *Psophia crepitans* Linn., and the white-backed trumpeters, *P. leucoptera* Spix.

Finally, the only two species of Dicholophi are both in the collection, viz.: the crested, *Cariama cristata* Linn., and Burmeister's seriema, *Chunga burmeisteri* (Hartl).

Among other noteworthy species of birds may be mentioned both sexes of the harpy eagle, *Thrasaëtus harpyia* (Linn.); two Cali-

fornia condors, *Gymnogyps californianus* (Shaw), one just shedding the last of its natal down while the other, at the age of three years, has just acquired the fully adult head colors and gular swelling; black cockatoo, *Calyptorhynchus banksi* (Lath); satin bower bird, *Ptilonorhynchus violaceus* (Vieill); and sacred ibis, *Ibis æthiopica* (Lath). A pair of ocellated turkeys, *Agriocharis ocellata* (Curv.), just acquiring adult plumage and coloring is perhaps the rarest species in the entire collection.

The series of American warblers is as complete as ever, and an excellent beginning has been made on the birds of our western deserts, as the following list will show: phainopepla, ptitilgonys, white-rumped shrike, western blue grosbeak, pyrrhuloxia, house finch, western lark sparrow, lark bunting, gambel sparrow, western vesper sparrow, Abert desert towhee, dickcissel, dwarf and red-eyed cowbirds, Sonoran redwing, Texas meadowlark, great-tailed grackle, Rio Grande green jay, besides many larger forms such as scaled quail, roadrunner, etc.

C. WILLIAM BEEBE,
Curator of Ornithology

INTERNATIONAL CONFERENCE ON THE 1:1,000,000 MAP OF THE WORLD

At the Fifth International Geographical Congress at Bern, in 1891, Professor Albrecht Penck first proposed that the enlightened nations who were engaged in making maps of their own territories and of other countries should unite upon a common plan for the execution of a general map of the world. He suggested that the scale of the map should be 1:1,000,000, or about 16 miles to the inch, and that the separate sheets of the map should be so bounded by meridians and parallels that any one sheet would match any other except for distortion of projection, no matter by what country either sheet might be made. This proposal led to resolutions and discussions at successive geographic congresses and to several tentative maps made by Germany, France, England and the United States as essays toward the general plan.

At the ninth congress at Geneva in July,

1908, a resolution was presented by Mr. Henry Gannett, of the U. S. Geological Survey, with a view to the formation of an international committee to which should be entrusted the details of arrangement which should lead to more definite cooperation in the preparation of the world map. Following the adoption of that resolution and the recommendations of the committee at Geneva, the British government has recently sent out invitations to Austria-Hungary, France, Germany, Italy, Japan, Russia, Spain and the United States, for a meeting of the committee in London on November 16, to proceed with the standardization of the international map on the scale of 1:1,000,000. The British delegates will consist of representatives of Great Britain, Canada, Australia and India. At this conference the various details essential to an agreement on the preparation of a uniform map will be discussed and it is hoped adjusted.

The United States Geological Survey has for some time past been engaged in compiling maps of portions of the United States on the 1:1,000,000 scale and in accordance with a plan which is believed to embody the principal features on which agreement with other nations is expected.

In view of the interest which it thus has in the results of this conference, Messrs. Bailey Willis and S. J. Kubel, of the U. S. Geological Survey, have been instructed to proceed to London as representatives of the United States.

MR. KENNEDY'S BEQUESTS

By the will of John Stewart Kennedy, the banker of New York City, who died on October 31, in his eightieth year, bequests are made for public purposes amounting to nearly \$30,000,000. Seven of the bequests are of \$2,225,000 each, and are, respectively, for Columbia University, the New York Public Library, the Metropolitan Museum of Art, the Presbyterian Hospital in New York City, and to three of the boards of the Presbyterian Church. Bequests of \$1,500,000 are made to Robert College, Constantinople, and to the United Charities of New York. Bequests of \$750,000

are made to New York University and the Charity Organization Society of New York for its School of Philanthropy. Bequests of \$100,000 are made to the University of Glasgow, Yale University, Amherst College, Williams College, Dartmouth College, Bowdoin College, Hamilton College, the Protestant College at Beirut, the Tuskegee Institute and Hampden Institute. Bequests of \$50,000 are made to Lafayette College, Oberlin College, Wellesley College, Barnard College (Columbia University), Teachers College (Columbia University), Elmira College, Northfield Seminary, Berea College, Mt. Hermon Boys' School and Anatolia College, Turkey. Bequests of \$25,000 are made to Lake Forest University and Center College. A bequest of \$20,000 is made to Cooper Union. There are also a number of other bequests to hospitals and charities.

Mr. Kennedy was a liberal benefactor in his life time and probably stands third among men in the history of the world who have given most largely for public purposes.

SCIENTIFIC NOTES AND NEWS

PROFESSOR J. H. VAN AMRINGE, head of the department of mathematics in Columbia University, and dean of the college, will retire from active service at the end of the present academic year, when he will have completed fifty years of service for the institution and reached his seventy-fifth birthday.

THE Bakerian lecture before the Royal Society will be given on November 18 by Sir J. Larmor, on "The Statistical and Thermodynamical Relations of Radiant Energy."

PROFESSOR JOSEPH P. IDINGS is at present traveling along the east coast of Asia. In September he visited the southern part of Manchuria, making a study of certain Cambrian rocks there. He expects to visit Manila about thanksgiving time, and while there will take occasion to see something of the volcanoes on the island of Luzon.

DURING the past month the newspapers have printed more or less sensational and alarming reports with reference to a geological exploration party which made a trip during the summer to the east shore of Hudson Bay under

the leadership of Dr. C. K. Leith, of the University of Wisconsin. Under these circumstances it will be gratifying to acquaintances of the members of the party to learn that they have reached the railway north of Cobalt, Ontario, and will be in the United States before this notice is printed.

THE Telford gold medals of the British Institution of Civil Engineers have been awarded to Professor B. Hopkinson and G. R. G. Conway; the Watt gold medals to D. A. Matheson and W. C. Popplewell and the George Stephenson gold medals to E. H. Tabor and A. J. Knowles.

A GOLD medal has been presented to Dr. Oswaldo Cruz in recognition of his services in extirpating yellow fever in Rio de Janeiro.

DR. THEODOR WEBER, emeritus professor of medicine at Halle, has celebrated his eightieth birthday.

DR. SIMON SCHWENDENER, professor of botany at Berlin and director of the University Gardens, will retire from active service at the end of the present semester.

DR. AUGUST BRAUER, director of the zoological museum of the University of Berlin, has been given the title of honorary professor.

AT Cambridge University Mr. H. H. Thomas has been appointed curator of the Botanical Museum, and Mr. C. L. Boulenger, assistant to the superintendent of the Museum of Zoology.

PROFESSOR HARRY SNYDER has resigned the chair of agricultural chemistry at the University of Minnesota, which he has held since 1892.

SIR WILLIAM TURNER has been elected president, and Professor G. Crystal general secretary, of the Royal Society of Edinburgh.

PROFESSOR L. A. HERDT, head of the department of electrical engineering at McGill University, has been appointed honorary secretary for Canada of the American Institute of Electrical Engineers.

PROFESSOR JOSEPHINE E. TILDEN, of the University of Minnesota, is at present in New Zealand, with leave of absence for a year for botanical research. Her courses at the Uni-

versity are being taken by Mrs. Frederic E. Clements.

DR. E. P. FELT, state entomologist of New York, has received a two-months' leave of absence for study in European museums.

PROFESSOR GUSTAV RETZIUS gave on November 5 the annual Huxley lecture before the Royal Anthropological Institute. His subject was "The North European Race."

ON Mondays and Thursdays, from five to six P.M., in the Harvard Medical School, Professor W. T. Porter will give a physiological demonstration with an informal lecture.

COMMEMORATION exercises were held at the Massachusetts General Hospital, on October 16, in honor of the anniversary of the first use of ether by Dr. William T. C. Morton. Dr. Charles W. Eliot delivered the address.

DR. WILLIAM TERRY HARRIS, for many years U. S. Commissioner of Education and eminent for his contributions to education and philosophy, died on November 5, at the age of seventy-four years.

THE death is announced of Dr. C. Gottsche, director of the Hamburg Geological Institute.

A TABLET in memory of Ross Gilmore Marvin, the Cornell graduate and instructor who was drowned while on the Peary expedition to the north pole, will be placed in Sage Chapel by the students of Cornell University.

IN view of the rapid rate at which accommodations are being taken up for the transatlantic passage for the spring of 1910, it seems advisable to call the attention of those intending to participate in any of the scientific congresses of next summer to engage their passage as soon as possible. In the middle of October every place on the North German Lloyd boats running to the Mediterranean next June was already engaged, except some at a high price. Some of the other lines are nearly as fully engaged.

SIR RAY LANKESTER writes to *Nature* that he has heard from the representatives of the late Professor Anton Dohrn to the effect that the Zoological Station at Naples remains the property of the heirs of its founder. Neither the German government nor any German so-

ciety has acquired any rights in its future disposition. Dr. Reinhardt Dohrn, who has for two years been the acting director of the station, is now director, and has inherited from his father (by agreement with his brothers) the actual property and the leases granted by the Naples municipality as to the site.

THE British Medical Association will hold its annual meeting next year in London under the presidency of Dr. H. T. Butlin, president of the Royal College of Surgeons. The association has held its annual meeting in London on three occasions. The first was in 1862, when Dr. George Burrows was president; the second in 1873, when Sir William Ferguson was president; the third in 1895, when Sir J. Russell Reynolds was president.

THE Central Association of Science and Mathematics Teachers will hold its annual session at the University of Chicago on November 26 and 27.

A BRANCH of the hygienic laboratory of the department of health of New York state has been established at Ithaca, under the supervision of Professor H. N. Ogden.

ACCORDING to a dispatch from Vienna the Austrian government will put upon the market a portion of the 154 grains of radium chloride, the product of the St. Joachimthal (Bohemia) plant, for 18 months. The Vienna hospitals and scientific institutions are to be supplied first, free of cost, the remainder to be offered for sale at \$75,000 a gram.

THE *British Medical Journal* says: The Pasteur Institute, Paris, will shortly come into possession of a capital sum estimated at 30,000,000 francs, the product of the estate of the late M. Osiris, which is now being realized. The circumstances under which M. Osiris determined to dispose of his great fortune in this way are, if rumor speaks true, most striking and dramatic. In 1903 M. Osiris founded a triennial prize of £4,000, to be given to "the person who had rendered the greatest service to the human race during the three preceding years." The prize was awarded to Dr. Roux, director of the Pasteur Institute, for the discovery of the anti-diphtheria serum. Instead of devoting the

money to his own private purposes Dr. Roux made over the sum to the Pasteur Institute. This self-denying action so impressed the millionaire that he left the bulk of his fortune to the institute as a token of admiration for the scientific attainments and self-abnegation of Dr. Roux. M. Osiris could not have made a better disposition of his wealth; the Pasteur Institute is greatly in need of funds, and this endowment will firmly establish it as a monument worthy of the great master. The memory of M. Osiris as a benefactor of the human race is effectively perpetuated by this princely munificence, and the scope and influence of the valuable work of the Pasteur Institute will be vastly increased.

WE learn from the *London Times* that the new Astronomical and Meteorological Observatory at Hampstead, the undertaking of the Hampstead Scientific Society, is now nearing completion. On the reservoir, near the Whitestone Pond, Hampstead-heath, are to be seen the small observatory house and the railed enclosure in which will be placed those meteorological instruments that require to be in the open. It is expected that the next fortnight will see the telescope placed in position, and the rain gauge, thermometer screen, sunshine recorder and barometer ready to give account of the climate of London's highest hill. The revolving dome of the telescope house has been designed and made by Mr. John Reid, of Manchester, and the meteorological instruments are being supplied by Mr. James J. Hicks. The telescope, which has been presented to the society by Dr. F. Womack, professor of physics at Bedford College and St. Bartholomew's Hospital, is an equatorially mounted reflector; the mirror is by Sir Howard Grubb, of Dublin, and the mounting by Wray. To the appeal for funds to defray the cost a generous response has been made. The sum involved will be about £250, and towards this £239 has been received.

THE recently founded Italian national league against malaria held its first meeting on October 6 at Milan under the presidency

of Professor Baccelli. The *British Medical Journal* states that Senator Golgi, as chairman of the local organizing committee, delivered the opening address, in which, he referred to the vast improvement due to the law of compulsory supply of quinine to laborers; in a few years the mortality from the disease had diminished by three fourths. As regards agricultural and water-supply betterments, he recognized that so far the results had not been very encouraging; he hoped, however, that the laws made on the subject would not continue to remain a dead letter. In regard to human beings, the improvement was beyond all question. Where the measures were carried out rigorously, it had been shown by Negri that the disease disappeared so completely that not a single case was to be found in the following year. Golgi did not, however, think that the general adoption of prophylaxis by the systematic administration of quinine to healthy people was justified. On the other hand, mechanical prophylaxis by the use of mosquito netting on the doors and windows of dwellings gave satisfactory results. The efforts of the league should, he urged, be directed to the application and perfecting of the methods already known, and to the study of new means of combating the disease. Professor Baccelli, who next spoke, suggested that a national, or even an international, congress against malaria should be held in Rome in 1911. Then the league would have the opportunity of demonstrating publicly the work it had done up to that time. He announced that the government would hand over for the purposes of the league the profits made on the sale of quinine by the state. The central committee was then constituted as follows: Professor Baccelli, president; Professor Golgi, Professor Lustig, Professor Gosio, Dr. Picchi, Professor Gobbi, Professor Di Mattei, Professor Canalis, Senator Ponti and Signori Badaloni, Villaresi and Cabrini.

UNIVERSITY AND EDUCATIONAL NEWS

THE appropriation for the College of the City of New York for the year 1910 amounts to \$613,000. Of this sum \$440,000 is for instruction.

By the will of the late Mrs. Gardiner Green Hubbard the sum of \$50,000 is bequeathed to the Clark School for the deaf at Northampton, Mass.

THE tenth industrial fellowship to be established under the management of Professor Robert Kennedy Duncan has been presented to the University of Kansas. It is for the investigation of the chemical treatment of wood, and is of the value of \$1,500 annually for two years. The donor is a furniture firm.

FIRE started last week in the basement of Culver Hall, Dartmouth College, where the laboratories of the chemistry department are located. Considerable damage was done to the scientific apparatus, and the building is temporarily closed for repairs.

THE entire board of regents of the University of West Virginia will spend two weeks in January studying the University of Wisconsin in its organization, methods of instruction, buildings and equipment.

DR. ERNST J. BERG, of the General Electrical Company, has been appointed head of the department of electrical engineering at the University of Illinois. In this position he succeeds Professor Morgan Brooks, who is at present abroad, and who will return to take up his duties as professor in the department.

THE department of physics and electrical engineering at the Iowa State College has been divided into two distinct departments. Professor L. B. Spinney will continue the head of the department of physics, and Professor F. A. Fish has been appointed the head of the electrical engineering department. A new building has been completed for the work of the electrical engineering department.

THE departments of geology and geography at Cornell University have been reorganized and divided into five coordinate departments. These are geology, in charge of Professor Henry S. Williams, who is also director of the museum; physical geography, in charge of Professor Ralph S. Tarr; stratigraphic geology, in charge of Professor Gilbert D. Harris; economic geology, in charge of Professor Heinrich Ries, and mineralogy and petro-

graphy, in charge of Professor A. C. Gill. Professor Gill will also be chairman of the five departments.

MR. RALPH HOAGLAND has been elected professor of soils at the University of Minnesota.

DR. W. W. DIMOCK has been appointed associate professor of pathology in the veterinary department of the Iowa State University and pathologist to the experiment station. For the last three years Dr. Dimock has been in the employment of the Cuban government.

RECENT appointments at the New Hampshire College of Agriculture and the Mechanic Arts are as follows: T. S. Arkell (B.S., Ontario '07), assistant professor of animal husbandry; Frank C. Moore (A.B., Dartmouth '02), assistant professor of mathematics; T. G. Bunting (B.S., Ontario '07), instructor in horticulture; L. A. Pratt (B.S., New Hampshire '09), instructor in chemistry; W. C. O'Kane (A.B. and A.M., Ohio State), instructor in entomology.

THE following new appointments have been made in the chemical department of the University of Illinois for the current year: *Instructors*: R. H. Jesse, Ph.D., Harvard University, L. L. Burgess, Ph.D., Harvard University, Ellen S. McCarthey, Ph.D., Cornell University; *Research Assistant*: L. P. Kyriakides, Sc.D., University of Michigan; *Assistants*: R. H. Stevens, M.S., University of Chicago, L. F. Nickell, B.S., University of Illinois; *Graduate Assistants*: W. T. Murdock, R. W. Savidge, L. M. Burghardt, F. W. Kressman, C. E. Millar, J. W. Marden, C. J. Baker, R. S. Potter; *Fellows*: A. W. Homberger, C. E. Burke.

DR. ALFRED GRUND, of Berlin, has been appointed professor of geography, in the German university of Prague, to succeed Professor Olenz, who has retired.

DISCUSSION AND CORRESPONDENCE

AUTONOMY FOR THE UNIVERSITY?

America has not yet contributed her share to scholarly creation, and the fault lies in part at the doors of our universities. They do not strive enough in the impressionable years of early manhood to stimulate intellectual appetite and ambi-

tion; nor do they foster productive scholarship enough among those members of their staffs who are capable thereof.

THESE words, indicative as they are of a courageous desire to attempt the mastery of one of the most complex problems of higher education of the day, I heard uttered by President Lowell in his inaugural address in the Harvard Yard.

In some respects the aims of the college and of the university are different or even antagonistic. The college strives to impart knowledge, the university to extend its boundaries. The college is the husbandman, the university the explorer in intellectual fields. Without the explorer's spirit for research knowledge crystallizes into mere erudition, but the college itself is of more fundamental importance, for without its fostering influence culture itself must wither into barbarism.

Indeed, our times demand a broad foundation in general culture for the erection of the pinnacle of special training, and thus it is that our best schools of law and medicine are now demanding that those who enter shall be college graduates. It is the aim of modern education to teach the student to know a little of many things and much of some one thing, and even more important is it for the graduate to realize that he knows but little of all things, and that far beyond the range of his intellectual vision stretches the unknown inviting his exploration. There are, therefore, two sharply contrasted aims in higher education—the foundation in general culture which it is the duty of the college to impart, and surmounting it that special training which only the professional school can give.

In other words, the wealth of modern knowledge has brought about a separation in aims between the college and the university, and necessitates a segregation of their faculties, while at the same time making the university more than ever dependent upon the college for that basic store of learning from whose safe boundaries expeditions into the unknown may be launched. Yet in America to-day our so-called universities are but overgrown colleges, and their graduate departments are still mainly normal schools for the training of

college teachers. Moreover, the historic experiments in education evidenced by Johns Hopkins and Clark Universities have shown that in our country the university can not stand alone without the coordinated support of its preparatory school—the college.

Research suffers grievously in our overgrown colleges through our failure to realize that there are two sorts of intellectual leaders in the world—those who are erudite expounders of learning, and those who advance its boundaries.

In manufacturing and in commercial walks of life it has long been known that the highest results are achieved only through a judicious division of the tasks with respect to the several abilities of those who are to perform them, and in our system of education the greatest efficiency will be attained only when the productive student is not overburdened with elementary teaching, and the erudite is expected to teach rather than to discover. Yet at the present day little or no such segregation is attempted, and indeed the tendency is increasingly to overwhelm the young investigator with pedagogical duties.

Most pernicious to the development of the spirit of research is the extraordinary growth of summer schools in connection with our colleges; and the consequent demand that young instructors forego research and teach throughout the year. In many of our colleges the young men are now forced to teach in summer schools, but even where this is not actually obligatory their small salaries practically necessitate it.

There have been summer schools such as that of Penikese years ago, whose ideal was research and whose aim was discovery, but the hurried and superficial teaching of the present-day college summer school places it not among these. But while it is the proper aim of the college to develop and above all to improve the summer school, its presence in its present form is most hurtful to the progress of university research.

It is the aim of the college to teach, it is the hope of the university to discover; and the demand of the university spirit of the day is

that it be given autonomy to solve its problems in cooperation with, but not under the control of, the college.

The cause of knowledge would be advanced by the establishment of schools of research in connection with our great colleges, and by permitting them, as in Germany, to elect their own faculties from among those college teachers whose genius is for discovery rather than for exposition of knowledge.

ALFRED G. MAYER

NATIONAL EDUCATIONAL RESPONSIBILITIES

"OUT of a full heart the mouth speaketh." The hour will come when valiant Dr. E. C. Moore will clearly recognize as blessings in disguise the great obstacles he has overcome in one of the most dastardly and malicious attacks the school system of an American city has yet encountered. Full endorsement of his general views, as expressed in a recent issue of *SCIENCE*,¹ is given freely and from somewhat varied experience of the most convincing character. The questions catalogued in the article cited are such as insistently demand settlement, and it would be a large step forward to realize, in some way, authoritative answers to these queries and to many others of equivalent importance in education, which now can not reach a final bar of judgment, except by tortuous indirection. Perhaps the dignifying of the U. S. Commissioner of Education with title and prestige of a member of the president's cabinet might go far to accomplish this end. And there is, no doubt, greater need and greater reason for such action than for certain similar schemes promulgated for advancing less vital and more selfish interests.

While thus completely in accord with Professor Moore in his advocacy of increasing the powers and responsibilities of the national commissioner, it is difficult to understand how this measure, of itself, can rectify the evils outlined in the aforesaid article, and those especially which have been heretofore the chief obstacles in the pathway of the superintendent of schools of Los Angeles and his coworkers. The poorly devised (*sic*) system in California,

which almost invites conflict of city council and board of education in financial estimates, might be deprecated by a national secretary, but state legislatures are bomb-proof and wholly invulnerable, save by one kind of ammunition, viz., the ballots of the voters. Mr. Moore's own recent victory in Los Angeles illustrates this fact conclusively, and it is difficult to understand how any added power within practicable bounds could have rendered even an official of the president's council more effective in meeting this unseemly attack than was the aroused public opinion at the most critical juncture.

In so far as the strengthening and enlarging of the power and scope of the national department of education may be effective in the unbiased study of many complicated problems and in the wider dissemination of facts and comparisons among the people, no obstacle should be thrown in the way of this proposition. But the fact remains that the machinery by means of which reforms must be introduced will not be changed materially by any such method. Undoubtedly there are serious limitations now to the possibility of desired accomplishment—limitations which the suggested plan might overcome to a great extent. The history of the administration of the Hatch and Morrill funds under the department of agriculture encourages the belief that revolutionary results might be expected to follow the judicious institution of similar bounties with more general application to primary and secondary education. And the reactionary influence of this same agricultural department upon the school systems of rural districts is a telling argument indeed. We certainly have no quarrel with the advocates of a strong department of education at Washington.

What the present writer aims to emphasize here is the paramount importance of more closely relating the general public to the school system. Dr. Moore asks with feeling born of bitter experience (but crowned with fresh laurels of victory won in this very controversy): "Shall the city board of education fix the amount of money required for school purposes each year, or shall the

¹ October 8, 1909, p. 470.

most corrupt and most inefficient of American institutions, the city government, do it?" Probably the querist is not aware of the form in which the question might have been as aptly put some years ago by a worthy predecessor in the same position in the same city of Los Angeles, and with the same feeling born of equivalent experience, but with tables turned. There was a time here when "the most corrupt and most inefficient of American institutions" was the board of education itself. And the present so-called "non-partisan" board, honorable and capable and efficient as it is, must be regarded, *in toto*, as almost unique among the boards of its class in this city. There was a plenty of vicious candidates to run against these men; and there would be many now of self-seeking politicians, if the people had not at last awakened and come into their own.

This, then, is the conclusion of the whole matter. There is no process or method or subterfuge, no manner of means whereby the lifeblood of the common school system may be kept pure and wholesome, save in the healthy growth and expression of public sentiment. No politician can withstand this weapon and no unworthy person can secure the power to harm, if all who love and revere the true spirit of American institutions will simply recognize their own relations to the schools when they cast their votes. With good officers in place, it matters very little what body politic assigns the funds; it will be well done by either one. With bad men in power, it matters not, likewise; for no good can come of it, anyway. As a matter of business wisdom, the authorities most closely in touch with the needs of the school ought to be given the most extensive powers relating thereto. But, with efficient public servants, the best possible arrangement is one which throws the initiative power and responsibility upon the general in direct command. The least possible interference consistent with resources and environment makes for the greatest economy and efficiency in the end. Boards of education, city councils and similar representative bodies should be mainly counsellors and legislators,

and the bestowal of patronage should be beyond their reach.

One peculiar feature of our school system is positively ridiculous when thoughtfully considered. This is the eligibility of the notoriously ignorant to positions demanding knowledge. A man unable to read or write may readily acquire power to decide upon the teaching of reading and writing. Educational qualifications are demanded of teachers, and now of public servants in most positions of the most ordinary importance, outside of educational boards of control. There can be no field where lack of such a requirement is more lamentable than in school supervision.

The vast influence of the National Educational Association in harmonizing and adjusting the diversity arising from varying state and local systems amply justifies the hope that a more concentrated and authoritative department of the government, well supported, as are other more narrow and more clannish interests, might accomplish far more than can be predicted in set terms. And the greatest of its aims should be to collect, arrange and disseminate accurate information regarding all phases of educational problems. The department of agriculture, ably conducted, has not only built up a cult of investigators, but in connection with the training of these, it has revolutionized agricultural education in the whole United States; and these important results to the rural districts are far more already than has been accomplished by all the worthy work of mere educators and their machinery in the same field. Educational experiment stations, sorely needed, have failed for lack of support. Agricultural experiment stations, fostered by a government department, have waxed strong and forced their way to recognition and reputation among the farming communities. We need strong support for like investigations in human culture.

For the crime, disease and ignorance of this generation, history is responsible, all credit for slow and sure amelioration being likewise credited to the account. For what remains after us to clog the veins of humanity, we must

be held more blamable by reason of our better realization of the remedies available.

THEO. B. COMSTOCK

LOS ANGELES, CAL.,
October 15, 1909

INTERNATIONAL LANGUAGE

TO THE EDITOR OF SCIENCE: In SCIENCE for October 22 Mr. J. D. Hailman has set forth with admirable clearness some of the reasons why scientists should adopt an artificial international language. Your readers will be interested to know that the whole question has recently been thoroughly discussed in a book called "Weltsprache und Wissenschaft," published by Fischer in Jena. This book, which is in itself an interesting sign of the internationality of present-day science, written as it is by five university professors belonging to five different countries: Couturat (France), Jespersen (Denmark), Lorenz (Switzerland), Ostwald (Germany) and Pfaundler (Austria), contains also an account of the most recent development of the international language movement, with which Mr. Hailman does not seem to be familiar and which you will therefore allow me to sum up here.

In October, 1907, an international scientific committee, elected by some 300 societies of various countries and presided over by the famous chemist Ostwald, met in Paris to decide which of the many proposed artificial languages would be best for international communications. After a careful investigation of Esperanto, Neutral, Universal, Novilatin, Langue Bleue and several other systems, the result was unanimously arrived at that none of these languages was quite good enough, but that Esperanto might serve as a basis, provided it were thoroughly modified and improved on certain specially indicated points. A smaller committee was selected to work out the details of this language, which is now before the public in the shape of dictionaries, grammars and readers in eight or nine different languages; the English ones may be had at Brentano's, New York. In spite of the short time this interlanguage (generally called Ido) has existed, it has already gained a great

many adherents among Esperantists as well as among those who had been deterred by many of the forbidding features of that language. Propaganda clubs have sprung up in a great many cities, some old Esperanto periodicals have adopted the new language, and new periodicals have come into existence, while a duly elected academy has charge of the further development of the language.

This may be described as a purified Esperanto, freed from all the arbitrary word-coinages and word-clippings of that language, freed also from its illogical and insufficient rules of word-formation, and last, but not least, from its clumsy alphabet with circumflexes over *c*, *s*, *g* and other letters. (Fancy an international language that can neither be telegraphed, nor printed in every printing office!) From another point of view Ido may be described as a systematic turning to account of everything that is already international in words, derivative endings, etc. Every one can easily master such a language because it is nothing but what has well been termed the "quintessence of European languages." A few lines will enable the reader to compare Esperanto and Ido and to judge for himself with regard to their general character. (In the Esperanto specimen the circumflexed letters have been printed as *ch*, *sh*, etc., according to a practise allowed by Dr. Zamenhof.)

ESPERANTO

Kiam chiuj tiuj, kiuj volas la sukceson de la lingvo internacia, konos chiujn kondichojn de la problemo, tiam oni konstatos, ke malgrau siaj bonaj ecoj, Esperanto devas ricevi shanghojn, char mankas en ghi multaj radikoj, ne sole por la sciencoj, la artoj, la profesioj, sed ech por la simplaj bezonoj kaj ideoj de la vivo ordinara.

IDO

Kande omni ti qui volas la suceso di la linguo internaciona, konocos omna kondicioni di l' problemo, lor on konstatos ke malgre sa bona qualesi Esperanto devas ricevar chanji, pro ke mankas en ol multa radiki, ne sole por la cienci, la arti, la profesioni, ma mem por la simpla bezoni ed idei di la vivo ordinara.

OTTO JESPERSEN,
Exchange professor,
Columbia University

OXYGEN AS WELL AS WATER PROVED TO EXIST IN
THE ATMOSPHERE OF MARS

IN SCIENCE for January 29, 1909, I announced that I had determined the amount of water vapor in the atmosphere of Mars by quantitative measurements of the relative intensification of little *a* in its spectrum, as exhibited in the Mars-moon spectrograms taken by Dr. Slipper at the Lowell Observatory. Through the kindness of Dr. Lowell, I have been enabled to continue the examination of these plates, and with improved facilities, I am now able to add the definite establishment of a relative intensification of the oxygen bands in the spectrum of Mars.

In my previous communication, an earlier paper in the *Philosophical Magazine* was referred to, but not quoted, in which I ascribed Dr. Slipper's success to his having made use "not of the comparatively feeble 'rain-band' near *D* which has been the subject of much contention in the past, but of the much more powerful water-vapor band '*a*' in the extreme red." This might be interpreted as meaning that though little *a* is intensified in the spectrum of Mars, the rain-band near *D* is unaffected, although I had no intention of making such an assertion. Dr. Slipper did, indeed, say that "the spectrum of Mars shows no selective absorption not found in that of the moon photographed under the same conditions";¹ but his obvious meaning is that other Martian absorption bands, though doubtless present on these plates, are too feeble to be certainly distinguished in the presence of telluric bands of the same wavelength. I should say the same myself of any *immediately* apparent intensification of the rain-band or of the oxygen bands in the spectrum of Mars; but it is well known that by sufficiently delicate methods, and by taking the average of a large number of observations, almost vanishingly small quantities can be evaluated. The reliability of the measurement must be tested by its probable error, and by a thorough investigation of the possible sources of error. I have now made such an investiga-

¹ *Astrophysical Journal*, 28, p. 403, December, 1908.

tion of the relative intensity of great *B* in the spectra of Mars and the moon at equal altitudes, and find that *B* in Mars is more intense by an amount eight times as great as the probable error, thus confirming the existence of oxygen in the atmosphere of the planet. Lowell Observatory Bulletin No. 41 may be consulted for the details of the observation.

In SCIENCE for March 26, 1909 (p. 500), Professor Campbell reproves me for not knowing that "*the effects of oxygen and water vapor on Mars were no more visible in the region λ 5400- λ 6900 of the spectrum than were the effects of oxygen and water vapor existing on the moon!*" (Italics and exclamation point are Professor Campbell's.) The reason why I did not mention facts which Professor Campbell considers so obvious as to require only his statement to prove them, is that I already had evidence at that time that great *B* (λ 6867) is more intense in Mars; but because the probable error of the measurement with the apparatus then used was large, I waited until improved apparatus and more reliable results could be obtained before making the announcement.

Eight entirely independent series of measures were made on four plates, each containing three spectrograms. No computations were made until after the last measurement had been completed, and I had no knowledge whatever of the significance of the result until the computations were finished. Since every one of the eight series gave a positive result, and since the method was so guarded as to eliminate every source of possible error which is known to me, I have no hesitation in announcing the intensification of great *B* in the spectrum of Mars as a fact. Nevertheless, I must warn any one who seeks to repeat the observation that its verification will demand exceptional facilities, a long apprenticeship in the art of delicate photometric comparisons, and a good deal of patience and persistence. The measurement is much more difficult than the by no means easy one of the intensification of the little *a* band of water vapor in Mars. In illustration of the difficulty of the

latter observation, I may say that in trying to demonstrate it to visitors, the first objection is apt to be, "but I don't see any band." When, after some coaching, the faint hazy band is seen, the next assertion is usually that there is no difference in its intensity in different spectra; and it is hopeless to expect a verification of the delicate quantitative measurement, unless the would-be observer can acquire the requisite skill. It is important that the spectrograms of the water-vapor band shall be secured when the water vapor in the *total* terrestrial air column is in smallest quantity. A low dew-point at the earth's surface does not guarantee this condition, which, in general, is almost never present in summer. For this reason the spectroscopic data should be obtained in winter.

FRANK W. VERY

WESTWOOD, MASS.,
October 1, 1909

QUOTATIONS

THE HARVARD MEDICAL SCHOOL AND HARVARD COLLEGE

THE modern tendency to align medicine with the other professions as a graduate topic is a sound as well as an irresistible tendency. But we think that some authorities have fallen into a logical error in attempting to buckle end-to-end, in the required training of a physician, the present college curriculum, and the medical curriculum as it grew up in pre-university days. The courses provided by medical schools comprise many which afford a high type of culture looked at from any standard. He would be exceedingly narrow who should deny that many of the courses which are indispensable ingredients of a medical education are also essentially academic, and worthy components of anybody's education. We go so far as to regard practically all the studies of the first year and a half of the Harvard Medical School as in posse, if not in esse, studies of an academic rank, as cultural studies. In brief, we desire to see them, while maintaining their indispensable rôle in medical education, open to all persons who

have any hygienic aims or any anthropological interests.

We would not "let down the bars" to all who might care to wander about in medicine unguided. We should throw proper restrictions about these courses, such as are thrown about all other advanced courses by the faculty of arts and sciences. But we should offer, to be taken and counted toward the bachelor's degree under proper precautions, all these courses. Let us admit to them any persons who wish to study the fundamental facts of health and disease amongst all the other economic, sociological or anthropological facts which to-day make up the proper study of mankind.

By this device we should destroy forthwith the familiar bugbear of "counting twice" certain studies, under the "combined A.B. system," toward both A.B. and M.D. For we regard the diagnostic and therapeutic courses of the medical school as the essentially medical courses, and the other so-called fundamental courses as not merely medical, but in a broad sense biological. We consequently see no objection to including such courses in work for a bachelor's degree, though we foresee hesitation on the part of some of those who grew up when the medical school was virtually independent of the university, to acknowledge the sources of some of their own culture.

We deny categorically the danger of undue specialization in this field and have above called attention to some random examples of greater specialization by persons who later won their doctorates in other fields.

We insist that our plans, if carried out, would encourage academic freedom and would be in line with all that is good in the elective system. In fact, so harmonious are these ideas with the university system as it otherwise stands that we can lay claim to no originality whatever in the advocacy of our plans. In short, we ask for nothing more than a logical application to medical studies of principles which have long successfully governed the graduate school of arts and sciences.

In this event, some men would receive the

degree of doctor of medicine after about six years of university residence, to which, however, there must be added at least a year of hospital work, and these men, like many doctors of philosophy, would have a rather narrow education. Such an education is, however, less narrow than that of many Harvard doctors of philosophy, under our present system. Others would devote eight or even nine years to their university careers, and their training would be correspondingly broader. Surely there is room at the Harvard Medical School for these different classes of students. But, in any event, the six-year men can be excluded only by an act which will inevitably cut us off from an important and rapidly growing group of American institutions, the great middle western and western state universities. We may not need the numbers thus lost; surely we should not lose their influence, if we are to be national and not local in scope.

As we believe, the greatest of all the needs of the Harvard Medical School is free, and, so far as possible, untrammelled intercourse with every other department of Harvard and with every other American university. No small changes are necessary if our medical education is to be made thus elastic, but surely it can not injure Harvard College to broaden the elective pamphlet by the introduction of suitable courses, nor can it hurt the Harvard Medical School to broaden its scheme of admission, to bring itself into relation with American universities in general, and into correspondence with the Harvard Graduate School, if this be done without diminishing the requirements for the degree of doctor of medicine.

These results may be accomplished by the following arrangements:

1. Count towards the A.B. suitable courses in medical sciences. 2. Admit unconditionally to the medical school all holders of a respectable bachelor's degree. 3. Grant the M.D. (a) after not less than a fixed minimum of residence; (b) upon evidence of theoretical and practical attainment in the medical sciences (including the present admission re-

quirements) and in the clinical branches. 4. Establish a simple administrative mechanism for the degree of M.D., modelled after the present mechanism for the Ph.D. 5. Execute the above arrangements in the broadest spirit, to establish and preserve academic freedom, as exemplified in the greatest variety of preparation, of medical course, and of finished product. 6. Relax the present rigid organization of the medical school curriculum and lay stress upon the quality of our doctorate rather than the means of its attainment. 7. In all ways encourage the better students. Permit them to advance at their own rate and in their chosen paths.—*The Harvard Bulletin*.

SCIENTIFIC BOOKS

Life and Letters of Peter and Susan Lesley.

Edited by their daughter, MARY LESLEY AMES. In two volumes. Pp. ix + 526, 562, New York, G. P. Putnam's Sons.

The founders of American geology are only names to most of the living. Not one remains of those who were engaged on the surveys of 1836 to 1841 and only one survives of those who shared in the Pacific Railroad surveys. Tradition relates that many of the early geologists were mighty men; the record of their work and of their warfare has been transmitted to us, but, for the most part, their personality is unknown. Obituary notices, presented in societies, usually discuss only the value of the subject's scientific work and leave the reader anxious to learn something of the man. No such defect is present in these volumes, for here is revealed Professor Lesley¹ as he knew himself and as his friends knew him.

Peter Lesley's father, third of the name, was born in Philadelphia, son of a revolutionary soldier, who, coming from Scotland, had established himself in that city as cabinet-maker. Just as Peter third was about to enter the university, his father died and the young man was compelled to take the father's business in order to support the family. In

¹ Professor Lesley was always dissatisfied with his name and when he became of age he placed the "Jr." as a prefix instead of suffix; thenceforward he was known as J. P. Lesley.

due time he took to wife the daughter of John Allen, a woman of sprightly mind and artistic temperament, with, like himself, strong religious convictions. (J.) Peter, the eldest son, was born in 1819.

Ninety years ago, parents were not afflicted as now with grievous anxiety respecting the health of their children, and boys, especially eldest sons, found themselves scaling the heights of Parnassus at a tender age. Young Peter was sent to the best school in Philadelphia, where he applied himself so well that when eight years old he gained the prize for an examination in Bonnycastle's algebra. At home, the father drilled his children in geography, mechanics, literature, statistics and above all in the accurate use of language, so that Lesley could well say in later years:

He started us in our careers equipped for seeing, thinking and describing what we felt to be useful and beautiful as what we believed to be true.

Professor Lesley was a nervous, excitable youth and his health gave way frequently, but then, as in after life, he exhibited remarkable recuperative power. After many interruptions, he was graduated from the University of Pennsylvania in 1838 but with health so broken that he could not begin study for the ministry, as he had intended. By advice of Dr. Dallas Bache, he sought and obtained from Professor H. D. Rogers the position of assistant on the geological survey, which he retained until the close of the work in 1841. The letters during this period show the strange combination of temperaments which made him so delightful a companion in later years. The keen observer of actual conditions and the impressionist artist struggle for supremacy, while at times a philosopher of medieval type bursts in with abstruse discussions. A curious grouping in a lad of twenty, which gives to his letters an incomparable charm. These letters tell much of his associates on the survey; one shows that geologists then had the same burden as now:

I got a lecture on geology from W[helpley], who complains bitterly that the landscape is ruined to him because he looks down on a valley and can't help saying, there's No. 7—that next

hill is No. 6, etc. In fact geology destroys all poetry and one can not be an Arcadian, as long as he knows what formation he's standing on and what one he is looking at.

The survey came to an end, Lesley entered Princeton Seminary, graduated in 1844, was licensed to preach and went to Europe to make a pedestrian tour. Returning, he spent two years as colporteur among the Pennsylvania-Germans and then went to Boston to complete the Pennsylvania geological map for Rogers. In 1848 he assumed the pastorate of a congregational church at Milton, Mass., and early in the following year he married Susan Inches, daughter of Judge Lyman, of Northampton, Mass.

According to all accounts, the young couple began married life with very little to encourage their friends. They had bad prospect of health and worse prospect of pecuniary support, for Lesley's position as clergyman was precarious, owing to his theological views. They were wholly contrasted in temperament; she calm and loving quiet, he restless and loving excitement. But their friends erred. The marriage in 1849 was the beginning of an ideal life, which ended only with his death in 1903. They lived happily in Milton for three years amid most attractive surroundings. The letters during this period show how broad their social relations were, for they tell of Channing, Desor, J. Freeman Clarke, Lesquereux, Edward Everett Hale, Agassiz, Emerson, Lyell and a host of others in science, literature and theology, who were entertained in the hospitable little house at Milton.

In 1852 Lesley entered the employ of the Pennsylvania Railroad Company with his office in Philadelphia, and in August of that year the young couple removed to that city, where for forty-one years they were increasingly influential. He soon became secretary of the Iron Masters' Association and librarian of the American Philosophical Society. In 1863, the railroad company sent him to Europe to study methods of hardening the surface of rails and to investigate the Bessemer process. During a stay of three months he found opportunity to renew old acquaint-

ances and to make many new ones and his letters give interesting glimpses of the men. Here is one on Lyell:

I must tell one of Sir H. Holland's jokes on Lyell. He saw him running across the street to him one day saying, "Have you heard the news?" "No is Lucknow relieved?" "Oh, I don't know anything about Lucknow—but haven't you heard that we have just got another new marsupial from the dirt-bed at Lyme?" I find Lyell just as nervous as ever—more so in fact—and far more interesting.

In 1866, after a year of tremendous work as expert, his health gave way and he was compelled to go abroad, where with Mrs. Lesley he spent twenty months, wandering as far as Palestine and the Nile. They returned to Philadelphia in 1868 and soon afterwards occupied the home on Clinton St., where they remained until 1893, when his final break came and necessitated removal to their house at Milton. With this return to Philadelphia, there began another period of incessant activity. The danger of poverty, prophesied by their friends, had passed away many years before, but Lesley's appetite for work was insatiable. Mrs. Lesley was scarcely less active in her sphere of organized philanthropy, to which her letters make only incidental references. Mrs. Ames has done well in supplementing them.

The life in Clinton Street is common property, for that house was a Mecca to which all scientific men turned when in Philadelphia, assured of a welcome which would make them think better of their kind. The story has been told so often that it need not be repeated here.

Any notice of this work, brought within reasonable compass, must be only a patchwork of fragments, giving no proper conception of its importance. The long unreserved letters, covering the period from 1838 to 1893, concern not the writers alone; they tell of men and women who have graven their names deeply in science, literature and even in politics; they throw interesting sidelights upon many obscure matters in our country's history, for the Lesleys were associated intimately with many who were leaders in great move-

ments. Mrs. Ames has woven the material so skilfully that Peter and Susan Lesley tell their own story and that of their time. The volumes contain numerous portraits, the last of which is copied from a painting made by their daughter, Mrs. Bush-Brown, not long before they passed away. Professor Lesley, old, feeble, yet cheerfully content, sits with one hand resting on the shoulder of Mrs. Lesley, who still retains the beauty of feature and expression which had endeared her to all acquaintances. The scene is the fulfilment of a prophecy made by Lesley almost fifty years before:

I half believe that when I am an old decrepit man, sitting all day in a well-worn armchair, my volatile and restless nature fixed like carbonic acid into a solid, snow-like equanimity, she will be briskly moving about me like a bright planet around a gone-out sun, and returning to me the little borrowed light and heat that I have ever been so happy as to give her.

Professor Lesley passed away in June, 1903; Mrs. Lesley survived him, but she faded away gradually, until the following January death came to her also. "They were lovely and pleasant in their lives and in their death they were not divided."

JOHN J. STEVENSON

The Cambridge Natural History. Edited by HARMER and SHIPLEY. Vol. IV. Crustacea and Arachnida. 8vo; pp. xviii + 566; 287 figures. London, Macmillan & Co. 1909. \$4.25.

This volume completes the set of ten of the Cambridge Natural History, and the editors are to be congratulated upon bringing to completion such a comprehensive work, one that exhibits so many excellencies and has been of such great service as a reference work to zoologists.

The delay in the publication of this last volume is due to the death of Professor Weldon, "who had undertaken to write the Section on the Crustacea"; he, however, completed only the chapter on Branchiopoda, while the remainder of the group has been written by Mr. Geoffrey Smith. The Crustacea occupy 217 pages. Chapter I. treats of

their general organization, with special treatment of the segmentation, appendages, body cavity and nephridia, alimentary, reproductive and respiratory organs. The nervous system is entirely omitted, also the musculature and moulting phenomena, and the treatment of the nephridia is rather superficial and not illustrated by figures. The second chapter, on the Branchiopoda, is by far the best on any section of the Crustacea, contains many new figures and unpublished observations on the habits, and terminates with useful keys for the identification of all genera of the Phyllopoda and all British genera of the Cladocera. The remaining chapters contain few new illustrations. Chapter III. deals with the Copepoda, IV. with the Cirripedia and Ostracoda (to the latter is devoted only a little over two pages), and Chapters V. and VI. with the Malacostraca. The parasite *Sacculina* is well treated, with interesting new observations. Parasitic castration is considered, also partial and temporary hermaphroditism (these terms are rather objectionable) and normal hermaphroditism. Phosphorescent organs are interestingly described, but in connection with the compound eyes no mention is made of the work of G. H. Parker. The remainder of the treatment is mainly taxonomic. Chapter VII. deals with the geographical distribution of the group, including the relations of fresh-water and marine faunæ, and the author accepts the view of Ortmann, for which there is now so much evidence, of an original land connection between the continents of the southern hemisphere. While the section on the Crustacea is clearly written, many important morphological phenomena are either omitted or mentioned most briefly.

The Trilobita are very well treated by Henry Woods in 31 pages, about two thirds of the account being devoted to their structure.

Professor Shipley gives in the brief Chapter IX. an introduction to the Arachnida, essentially in agreement with the views of Lankester. He subdivides the Arachnida into the Delobranchiata (though there is no good reason why this should replace the better known Merostomata), and Embolobranchiata; the

former includes the Xiphosura and Eurypterida, the latter the Scorpionidea, Pedipalpi, Araneæ, Palpigradia, Solifugæ, Chernetidæ, Podogona, Phalangidea and Acarina. He places the Tardigrada and Pentastomida as "appendices" to the Arachnida.

The Xiphosura are also treated by Shipley, in 21 pages. He follows Lankester in making the eye segment the first, the rostral the second and the cheliceral the third. There is no good description of the eyes or discussion of their homologies, and no figures of them, so that the treatment is decidedly scant, especially in comparison with that given by Korschelt and Heider in their "Lehrbuch."

The Eurypterida are well described by Henry Woods in 12 pages, with good figures from the best restorations.

Cecil Warburton has written the accounts of the remaining arachnid groups, the Embolobranchiata, and his treatment is a useful contribution, for this is the fullest text-book account yet given of these groups. The best part is the biological and taxonomic, for not much attention is given to the internal anatomy and almost none to the embryology. All the taxonomic families are characterized, though not in the form of analytic keys.

To the Scorpionidea are devoted 12 pages, with the internal anatomy given most briefly; to the Pedipalpi, 5 pages; to the Palpigradi, 2 pages; to the Solifugæ, 7 pages; to the Chernetidæ, 9 pages, with a list of all British species; to the Podogora (*Ricinulei*), 2 pages; to the Phalangida, 15 pages, a good treatment. In the greater number of text-books the preceding groups, with the exception of the scorpions and solifugids, receive only the barest mention. The large group of the Acarina is treated in 20 pages, too briefly.

The fullest attention is given, however, to the Araneæ or spiders, more than a hundred pages being occupied with this group. There is a good description of the external anatomy and the stridulating organs. But the internal anatomy is too briefly treated, the colulus and various salivary glands are entirely omitted, also the entapophyses, the endosternal structures (a most serious omission) and the

musculature. The author also fails to cite certain important memoirs, such as Gaubert on the lyriform organs, Wagner on the auditory hairs and moult, Lamy on the respiratory organs, and Menge on copulation and sperm transfer. The treatment of the habits (46 pp.) is excellent on the whole, for here Mr. Warburton is much more in his element, though few literature references are given; there is considered the moulting, behavior of the newly-hatched, architecture (especially good on the orbicular nares), poison, fertility, natural enemies, protective coloration and mimicry (at places these two are confused, and also the latter with aggressive coloration), the senses, intelligence and mating habits. With regard to hearing he concludes: "If there be any true hearing organ in spiders its location is quite uncertain"; it is strange he does not even refer to the work of Wagner, Dahl and Pritchett. Chapter XV., 38 pp., is the taxonomic treatment of all the aranead families, with notes on habits and distribution, the classification adopted being that of Simon; only a few of the families are illustrated by figures.

The chapter on the Tardigrada, 11 pages, by Shipley is excellent. He concludes "there can be no doubt that the Tardigrades show more marked affinities to the arthropods than to any other group of the animal kingdom," which is well in accord with our present knowledge. Shipley also contributes a brief but good chapter on the Pentastomida.

In 42 pages the Pycnogonida are well considered by D'Arcy Thompson, with a good account of the structure. There is an excellent figure of the male of *Boreonymphon* carrying the young. All the families are described. As to the genetic affinities he believes "that such resemblances as the Pycnogons seem to show are not with the lower arachnids but with the higher; they are either degenerates from very advanced and specialized Arachnida, or they are lower than the lowest. Confronted with such an issue, we can not but conclude to let the Pycnogons stand apart, an independent group of Arthropods."

We can say of this volume that what is

given is given fairly well, the errors are mostly of omission. The most serious omission is the lack of description of the embryology, for in certain of the groups no mention at all is made of the development, and in others nothing except a few larval stages are described. The reader might be led to believe that many of these animals do not have ontogenies! It may be fairly asked, how can any one form a good concept of an animal's structure without a knowledge of its development? At least short résumés of the ontogenies should have been presented. It also occurs to the reviewer that it would have been much better to have devoted two volumes to the groups treated in this one, just as two volumes have been given to the insects. Had this been done, the treatment of each group could have been much more comprehensive, the errors of omission avoided, and the work thus made much more valuable for reference.

Great praise is certainly due to the chapters on the Arachnids, for they help to fill a long-felt want; this group has always received scanty treatment in text-books, and the larger works are not accessible to most students. From most text-book accounts one would gather that the Arachnids are mostly scorpions! It is to be hoped that this last volume of the Cambridge Natural History will arouse wide interest in the group of the spiders, so interesting in structural specialization and instincts, and will lead, in our teaching, to the supplanting of the alcoholic scorpion by the living spider. And it is also hoped it will stimulate more students to investigate those neglected aberrant groups, the tardigrades, pentastomids and mites.

THOS H. MONTGOMERY, JR.

SCIENTIFIC JOURNALS AND ARTICLES

Internationale Revue der gesamten Hydrobiologie und Hydrographie. Unter Mitwirkung von ALBERT, FÜRST VON MONACO, ALEXANDER AGASSIZ, CARL CHUN, F. A. FOREL, VIKTOR HENSEN, RICHARD HERTWIG, SIR JOHN MURRAY, FRITJOF NANSEN, OTTO PETTERSSON und AUG. WEISMANN. Herausgegeben von BJORN HELLAND-HANSEN

(Bergen), GEORGE KARSTEN (Halle), ALBRECHT PENCK (Berlin), CARL WESENBERG-LUND (Hilleröd), RICHARD WOLTERECK (Leipzig) und FRIEDRICH ZSCHOKKE (Basel). Redigiert von R. Woltereck. Bd. I., XXII., 900, 76 pp., 21 Taf. Leipzig, Verlag Dr. W. Klinkhardt; New York, G. E. Stechert. 1909. M. 30.

The past ten years have witnessed the origin of more than a score of new journals or serials of a periodical nature, primarily with zoological contents or including zoology as one of their main fields. Some of these are the organs of institutions of research or of societies of investigators, new and old. Others owe their origin to single investigators or their schools, and still others are the logical outcome of the increasing tendency to specialization and represent particular fields of research. The journal in hand, which is now in its second volume, owes its origin in part to the last-named cause, but even more to a movement in the opposite direction of generalization based upon the cooperation of investigators and coordination of results in the different sciences concerned in the causal analysis of the problems of the biology of fresh waters and of the sea. Investigators in these fields of marine and fresh-water biology in which the sciences of botany, zoology, bacteriology, chemistry, physics, hydrography and physical geography are all intimately concerned, have long felt the need of a common journal or clearing house where all results bearing on the biological aspects of these problems may be published and where comprehensive reviews written from the standpoint of hydrobiology and an up-to-date bibliography might be found with more convenience, completeness and certainty than in scattered journals in these diverse sciences. The *Revue* bids fair to meet this need and to afford a most acceptable and efficient organ for the coordination of these several sciences by keeping each separate branch of study in constant touch with the advances made in all other departments, and to render effective service in extending and stimulating work in its field.

The international character of the journal is sufficiently indicated by the list of coadjutors, editors and contributors and the comprehensiveness of its scope is attested by its program, which appears in full in the "Prospekt," issued in 1908, which forms the introduction to the volume.

Above all, the editors recognize the necessity of a synthesis of our biological and hydrographic-geological knowledge of the waters. These two spheres of investigation are inseparable; since the water, whether as river, lake or sea, is never a factor in the shaping of the earth without being also a medium of life, and on the other hand, is never a medium for life without at the same time having an important influence in the shaping of the earth's surface.

As the biology of the waters has now passed from the description of what is found therein into the causes and origins of the animal and plant life and the phenomena accompanying it, the absolute necessity has arisen for the biologist to really understand the nature of the separate waters, their physics and chemistry as well as their form and the history of their bed.

On the other hand, with the advance of marine and fresh-water investigations (in brief, the study of the waters), it has also become necessary for the hydrographer and geologist to understand something of the biological factors, which are operative in the physico-chemical changes of the water as also in the formation of coasts, land and deposits.

The editors justify the inclusion of both fresh-water and marine fields in the same serial on the ground that a synthesis of results in the two is desirable because of their common, overlapping, or interdependent problems. They also express the hope "to bring into existence a helpful synthesis of the results obtained by the pure sciences and the practical or applied sciences."

Of the nearly 1,100 pages in the volume, 523 are given to original articles, usually upon topics of more general interest, 180 to summaries and critical reports, 80 to bibliographies and the remainder to short notices on scientific matters, on biological stations, expeditions, surveys and university courses in the field of the journal.

As might be expected from the composition of the board of editors the contents of the *Revue* are primarily zoological, only a single purely botanical title appearing in the list of original articles and but five in the field of hydrography. Noteworthy among these is a prodromus for a renewed attack with the "Fram" upon the problem of the North Polar Basin by Raoult Amundsen. There is also a predominance of fresh-water subjects (16) over those (5) from marine fields which is in part due to the editor's relationship to the new fresh-water station at Lunz in the Austrian Alps, and to the further fact that many investigators in the marine field are connected with the various branches of the International Commission for the Investigation of the Sea or other governmental or institutional enterprise of a similar sort having their own mediums for publication. Among the original articles of a general character are a Hydrobiological introduction by Professor Weismann in the closing words of which he reaffirms his adherence to the Darwinian point of view as to the efficacy of minute variations as over against mutations in the process of evolution. A second introductory article by Dr. John Murray on "The Distribution of Organisms in the Hydrosphere as affected by Varying Chemical and Physical Conditions" is a statement of problems and results in marine biology in the light of recent investigations in oceanography and limnology. Professor Richard Hertwig discusses the function of the fresh-water biological station in present-day research and Professor Issel contributes a general article on the biology of hot springs. Two pages of unusual general interest are those of Lohmann on the relation between pelagic deposits and the plankton of the sea and of Nathansohn and Gran on the general conditions of production in the sea.

Intensive work, on the other hand, is represented by Dr. Gotzinger's carefully wrought out limnological monograph on the Lunzer Mittersee, by Klausener's studies on the "blood lakes" of the high Alps, by Kratzschmar's experimental analysis of the polymorphism of *Anuraea aculeata* and by Pro-

fessor Fischel's elaborate studies of the intra-vitam staining of *Daphnia* in which the success of the new intra-vitam stain alazarin is shown. The "Sammelberichte" constitute one of the most useful parts of the journal. They deal with a wide range of subjects, from Brehm's article on the geographical distribution of copepods and their relation to the ice age to Steche's compressed summary of our present-day knowledge of *Hydra* and Franz's review of the latest results in the study of the migrations of fishes in the North and Baltic seas, and his discussion of the economic significance of recent discoveries in the life history of the eel. Of especial service are the authentic summaries of the work of various surveys and explorations, such as Collet's and Scourfield's accounts of the hydrographical, geological and biological results of the all too little known work of the Scottish Lake Survey, Cori's description of the work of the Adria Verein at Trieste, Entz's summary of the Balaton Lake investigations in Hungary, Juday's résumé of the exploration of the Wisconsin Natural History Survey, Zschokke's note on the results of the investigations of high alpine waters and Zuelzer's review of the recent work in Germany upon the biology of polluted waters, a subject deserving wider attention in our own country.

Notices (often illustrated) of the biological stations at Port Erin, Roscoff, San Diego, Monaco, Lunz, Plön, Sebastopol, of instruction in oceanography and related subjects in universities, of congresses, expeditions, etc., find a fitting place in the several "Hefte" of the *Revue*.

The original prospectus included a project for a continuous index of papers received and annual summaries of the year's production in the whole "science of waters." The first part of this program was wisely dropped with the issue of the first Heft, and the second obviously could hardly be completed in 1908. The difficulties which beset even the best organized and longest established "Jahresberichte" in the more centralized fields of research can only be adequately appreciated by those who perform the thankless drudgery of their preparation. In the diffuse field of hydro-

biology how much more difficult the organization and prompt completion of annual summaries requiring, as these do, the cooperation of specialists in less closely associated subjects! Nevertheless Professor Woltereck and his associates have undertaken the seeming impossible and Bd. I. contains as a supplement the first section of the Jahresübersicht for 1908 including: I., Limnography; II., oceanography; III., fresh-water botany; IV., marine botany; V., applied hydrobiology (polluted waters and water supplies); VI., fresh-water zoology (excluding vertebrata). The remaining parts (with Nachträge to those above named) will be issued in the current year. These are VII., marine zoology (excluding vertebrata); VIII., marine and fresh-water fisheries with supplement on "Aquariumkunde"; IX., potamology, moorkunde, thermal and cave waters.

Obviously a considerable part of this field (III., IV., VI. and VII.) is already covered in the long-established botanical and zoological summaries and bibliographies, but all too often imperfectly and not from the standpoint of hydrobiology. The other fields are sorely in need of just such summaries and bibliography as are here projected. Every worker in these fields should help on the project of securing complete and prompt representation of the literature by providing the *Revue* with reprints or notices of his work. Naturally there are many deficiencies in the parts now published, but they are to be expected in the initial stages of all such enterprises. The bibliography and summaries of literature form a supplement with independent pagination.

The new *Revue* should receive the cordial support and cooperation of all who are interested in the manifold phases of hydrobiology, whether descriptive, experimental or applied.

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THE TREATMENT OF CERTAIN TICK-TRANSMITTED DISEASES.

EVER since the discovery of the destructive effect of quinine on the causative organisms of

malaria, investigators have dreamed of the possibility of discovering similar therapeutic agents for use in other diseases caused by blood-infesting organisms. A recent paper by Messrs. Nuttall and Hadwen,¹ dealing with experiments conducted at the University of Cambridge, seems to indicate that drugs have been discovered which display the same destructive effect upon certain species of disease-causing species of *Piroplasma* as quinine has upon the organism of malaria.

There are four distinct diseases of domestic animals caused by as many species of *Piroplasma*.² Of these, splenetic or Texas fever occurs in various of the warmer parts of the earth and causes tremendous economic losses. Malignant jaundice of the dog occurs in India and South Africa and displays a very high lethality. Biliary fever of horses occurs in Africa, the loss is considerable. Carceag of sheep occurs in southern Europe and is considered an important disease. In all these diseases certain ticks have been found to be the agents of transmission.

In the experiments of Messrs. Nuttall and Hadwen the most remarkable results were obtained from the use of the stains known as trypanrot and trypanblau, in aqueous solutions injected subcutaneously. These were found to exert a direct and observable effect upon the

¹ Nuttall, J. H. F., and Hadwen, S., "The Successful Drug Treatment of Canine Piroplasmosis together with Observations upon the Effects of Drugs on *Piroplasma canis*," *Parasitology*, II., Nos. 1-2 (double number), pp. 156-191, July, 1909.

² In the literature the organism of the so-called Rhodesian fever of cattle is referred to as *Piroplasma parva*. However, Mr. Nuttall has pointed out that this species is not congeneric with those causing splenetic or Texas fever of cattle, malignant jaundice of dogs, biliary fever of horses and carceag of sheep. He has therefore erected the genus *Theileria* for the organism referred to as *Piroplasma parva*. This is especially interesting in view of the fact that the drugs which were found to have a most decided effect upon the true *Piroplasma* species did not exert any effect whatever on the parasite of Rhodesian fever.

parasites by causing the pyriform stages to disappear quickly and also to cause the total disappearance of the parasites from the peripheral blood. The action was most noticeable on the pyriform stage found in the plasma, which is exactly analogous to the action of quinine in malaria. However, the drugs apparently reached the stages within the corpuscles, causing them to show signs of degeneration. They presented a ragged and irregular appearance, quite different from the normal.

In the experiments with trypanblau ten dogs suffering with piroplasmosis were utilized. Failure to cure the disease resulted in only three out of the ten cases. In the failures distemper and other factors probably contributed to the death of the animals. This is especially likely in view of the effect noted upon the morphology of the organism in the microscopical examinations. In one case, which was repeated successfully, an injection of trypanblau twenty-four hours after inoculation prevented the appearance of the parasites in the blood of the dog which remained perfectly well.

In a note appended to the paper we are informed that trypanblau exerts a very prompt effect on the parasites of splenic fever. This effect is precisely similar to that on the organism of the dog disease with which the experiments were primarily concerned. It is thus permissible to assume that the agents used by Messrs. Nuttall and Hadwen may be of use in the treatment of this very important disease, as well as in others caused by similar organisms. We are informed that the authors have interested the Colonial Office and the Department of Agriculture and Fisheries in extensive practical tests. We are promised reports upon this work and upon further laboratory experiments at an early date.

The writer commends the paper as one of far-reaching importance. Moreover, it is a model in the treatment of an intricate subject. Full details of experiments are given so that the reader knows exactly what are the bases for the conclusions drawn.

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SPECIAL ARTICLES

DEMONSTRATIONS WITH THE MUSICAL ARC

THE musical arc offers a convenient means of demonstrating many important features of electromagnetic theory. It may be of interest, therefore, to give a brief description of apparatus and methods, with references to some of the more elementary experiments which have been found helpful.

As is well known, the musical or "singing" arc¹ is obtained by connecting in parallel with the direct current arc a system containing self-induction and capacity. The arc used without this parallel or "secondary" system may be more or less unsteady, showing at the poles sudden change of potential difference of considerable magnitude. The secondary system may be thought of as supplying the conditions for taking up these fluctuations, and, in turn, emitting electric oscillations of frequencies determined in large part by the secondary itself. These oscillations, reacting on the arc, cause fairly regular interruptions in the discharge, which therefore emits a musical note. The pitch of this note may be varied by changing the conditions of the arc-circuit as well as by varying those of the secondary.

Examination by a revolving mirror and by the spectroscope seems to confirm what might from general considerations be expected in an arc of this kind, viz., that although the arc is interrupted, the poles give the distinctly different and characteristic forms of discharge observed in the continuous arc.²

For purposes of demonstration, good results may be obtained by using a condenser with capacity which may be varied from 1 to 10 microfarads and which is capable of standing a potential difference of 1,000 volts. The coil for the secondary may be made with three hundred turns of No. 15 annunciator wire wound on a spool of 10 cm. radius and 3 cm. axial length. The arc is perhaps most easily maintained between carbon poles. Examined

¹ Duddell, *Electrician*, 46, 1900. Simon, *Phys. Zeit.*, VII., 1906. Austin, *Bulletin of Bureau of Standards*, 3, No. 2, 1907.

² Vide *Astrophysical Journal*, XXVIII., No. 1, 1908.

in a revolving mirror, the musical arc shows serrations which are strongly marked near that pole which would be positive for the uninterrupted arc. Therefore to minimize the effects of convection as well as those due to wandering of the discharge over the terminals, and consequent change of pitch of the note, the poles should be about 8 mm. in diameter, vertical, and the positive one below.

With the above apparatus, the arc, after burning until the positive pole is sufficiently coned, may be made to give a clear note of tolerably uniform pitch and audible throughout a fairly large room.

Both pitch and intensity depend not only upon capacity, self-induction and resistance in the secondary, but also upon the potential difference of the arc terminals. High potentials give clearer tones, but the 110-v. circuit answers very well. For a given secondary, a slight adjustment of arc-length or of resistance in the arc-circuit may make a striking difference in the clearness and intensity of the note. Using the 110 V.D.C. mains, a current of 1.5 to 2.5 amperes is necessary. Too much current produces a hissing or an impure note, or even none at all. The fact that the tones may not be pure³ does not interfere seriously with their use qualitatively as indicators of changes made in the various circuits employed. All connections should be very firmly made.

To show induced currents, incandescent bulbs may be used to advantage. Those of small resistance and for small potential difference are better, though of course easily burned out. Add to the above apparatus a few coils of various sizes, some metal plates, etc., and interesting demonstrations become at once possible. They depend on the change of pitch of the arc-note, or on the lighting up of incandescent lamps; these effects arising from modifications of the electrical conditions of secondary or tertiary circuits.

An obvious experiment is to vary the note by changes in the secondary, several octaves being easily obtained. This makes possible rough comparisons of self-inductions and of

capacities for oscillatory currents, by comparing the arc-tones with those from tuning forks. The use of the ordinary formula, $2\pi\sqrt{LC}$ for the period of the discharge involves the assumption of its applicability, as well as the further one that the resistance may be neglected. It may readily be demonstrated that the latter is only approximately true.

The short-circuiting of the coil in the secondary produces a note the shrillness of which gives an instructive idea of the part played by inertia in an oscillating electrical system. An incandescent lamp may be made to light up by joining it with a coil laid on the one in the secondary circuit. Rotating and sliding the upper coil are modifications that suggest themselves at once. For oscillations of very high frequency, the bulb will not light up, since the heating effect varies inversely as the frequency, if the latter is high and the resistance is negligible. Placing a coil in open circuit on the one in the secondary produces no effect; but the result of closing the circuit of the upper coil is to raise the pitch of the note, the increased frequency of the oscillations arising from the decrease in effective self-induction in the oscillating system.

It is instructive to close the upper coil alternately through each of two equal resistances, one of which is non-inductive. The difference of pitch may be made very striking.

If two coils are used in series in the secondary, the effective loading of the oscillating circuit depends on the position of one coil relative to that of the other. The maximum inductance, and consequently the lowest note, is obtained when one coil lies upon the other so that the directions of their fields are the same. This contrasts sharply with the high note emitted when the fields oppose.

An iron plate laid on the coil in the secondary increases the inertia of the system and consequently lowers the pitch of the tone. In this way it may be shown that a soft iron plate changes the arc-tone more than a steel plate of equal thickness does. A plate of non-magnetic metal raises the pitch. Such a plate may be regarded as a series of closed

³ Austin, *loc. cit.*

conductors. Interesting results may be brought out by comparing the effects of using solid metal plates and similar plates cut into sectors, insulated from one another. These results suggest the use of different forms of cores in a solenoid placed in series with the secondary circuit, or with the lamp and coil used to show induced currents.

The screening effects of conducting plates may be shown by placing them between the secondary coil and another coil in circuit with a lamp. For high frequencies, thin sheets of copper or of iron may cut down the brilliancy of the bulb very decidedly.

If a short-circuited coil is used instead of the plate, a similar screening effect may be shown.⁴

To show "resonance," arrange a second oscillating system containing capacity, self-induction, and a small lamp. If the coil of one system is laid upon that of the other, and the natural periods of the two systems are made approximately the same, the bulb lights up and the pitch of the note is changed. There is a considerable range of response in the second system, but with proper adjustment a maximum of light for varying frequencies may easily be observed. The use of two coils in series in this second oscillating system is convenient. One below the secondary coil and the other sliding on top of it makes the adjustment for maximum effect easier. The reaction of this new oscillating system on the secondary and thus on the arc may be very interestingly shown by making and breaking the new oscillating circuit while changing the capacity in the secondary circuit and noting the resulting change of pitch of the arc-note. The direction of this change depends on which of the two free periods is the greater.⁵

In conclusion it should be said that the above suggestions are made merely to call further attention to a means of demonstration which in some respects is simpler than the spark-discharge, and which has certain advantages over models.

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⁴ Cf. J. J. Thomson, "Recent Researches," § 427.

⁵ J. J. Thomson, "Recent Researches," § 432.

THE "ROCK WALL" OF ROCKWALL, TEXAS¹

For many years reports of a more or less definite nature have been circulated describing the wonders of the ancient wall surrounding the town of Rockwall, Texas. The writer was able during the past winter to spend a few days investigating this supposed historic structure. It proves to be not a wall, but a number of disconnected sandstone dikes, strictly speaking, not surrounding the town, but trending in many directions. As exposures are few, they have been discovered in such scattered localities in the town's environs as to suggest the idea that they were fragments of a ruined wall.

Rockwall is located in a rich farming district about twenty-five miles east of Dallas. Black waxy soil covers the rolling hills, and only where erosion has been considerable can the underlying rocks be seen. These, when exposed, reveal blue limey strata of upper Cretaceous age in nearly horizontal attitude. A white clay, the decomposed product of the lime muds, generally occurs beneath the black soil. These lime muds are remarkable in their freedom from grit and in the peculiar property which causes them to decrepitate when exposed to the weather; notable also in that, on drying, cracks develop of various sizes. Within this series of semi-consolidated beds a few sandy layers occur. One is revealed by a drill record 1,800 \pm feet below the surface; another may be seen near the town of Rockwall at the surface and consists of thinly bedded flaggy sandy limestone.

Though good exposures are infrequent, owing to the depth of soil, a peculiar condition affords ample opportunity to observe the dikes in place. These latter are natural courses for underground waters, and wells are often located on them. Though these walls are filled with water, the rock forming the dike, removed during the sinking of the well, may be examined at leisure.

The dikes are of various sizes, varying from an inch in thickness to eighteen inches or two feet. They stand vertically, or nearly so, and have in cases been followed downward fifty feet or more, always imbedded in the lime muds. They are composed of exceedingly fine-

¹ Published with the permission of the Director, U. S. Geological Survey.

grained quartz sands, cemented by calcium carbonate. So far as observed they do not vary appreciably in width through vertical range. Two joint systems, one nearly horizontal, the other vertical, have cut these dikes in such a manner as to suggest masonry walls, *i. e.*, they are composed of oblong blocks in horizontal layers.

Certain facts may be noted, however, which preclude this view. In a photograph at hand exposing a portion of the dike near Rockwall, it may be seen that many of the vertical joints occur above each other, *i. e.*, they are not broken, which condition would not exist in a wall constructed by hand. It may also be noted that the curve to the upper surface of one block exactly fits the curve on the under surface of the next block above, which leads to the same conclusion. The weathered sands between the joints, stained with iron oxide, have been mistaken for mortar.

To define accurately the steps which have taken place in the forming of these dikes is not as easy as to recognize the nature of the phenomenon. They may have originated in several ways. The sands may have come from above or from below. The cracks may be due to drying or to earth movements. The writer was not able to decide the direction from which the sands entered. Inasmuch as circulating waters have passed for long periods through the sands, dissolving and redissolving the cement between the grains, the original position of the latter can not be postulated. At present they show no signs of bedding. On breaking blocks, what might be called a stalagmatic fracture is obtained, *i. e.*, cylindrical or tubular forms arranged in vertical position. As has been pointed out, this may well be secondary structure induced by circulating water.

The limey muds were probably deposited in very clear quiet waters. A slight elevation of the sea or an increased supply of material from the land may have altered deposition and spread fine sands upon the muds. Cracks formed by earthquakes may have permitted unconsolidated sand to enter as a filling. Again, the muds may have undergone a dry-

ing-out process since their elevation above the sea, cracks may have formed from this cause, and overlying sandy layers aided by percolating waters served to supply material wherewith to fill them.

The joints may be ascribed to forces arising from slight warping of the earth's surface, acting on hard vertical masses imbedded in relatively plastic strata.

It is fair to say in conclusion that the believers in the theory which ascribes the origin of these dikes to prehistoric men are in the minority in the locality itself.

SIDNEY PAIGE

APOGAMY IN *OENOTHERA*

THERE seemed at one time a possibility that the phenomena of mutation in *Oenothera Lamarckiana* might be associated with a condition of apogamy in that species. A survey of the hereditary behavior, however, and particularly of the results of certain crosses between the mutants and *O. Lamarckiana*, and also among the different mutants themselves, soon made it apparent that such a condition could not be of high frequency at any rate, in the parent form or in such mutants as *O. rubrinervis* and *O. nanella*. The results of crosses between *O. Lamarckiana* or certain of its mutants, and such wild species as *O. biennis*, also could only be explained by assuming that fertilization had taken place uniformly in the ordinary way, and often the resulting hybrids show the predominating influence of the pollen parent.

But while it seems highly improbable that apogamy in *O. Lamarckiana* is concerned in the origin of the mutants, yet, as I shall proceed to show, there is some very good evidence that one at least of these mutants is itself apogamous, though only in a small percentage of cases.

Oenothera lata is well known to be sterile in its anthers, so that self-fertilization has never been effected. MacDougal¹ has reported that the form closely resembling *O. lata*, from near Liverpool, England, can be self-fertilized, and

¹ "Mutations, Variations and Relationships of the *Oenotheras*," Carnegie Inst., Pub. 81, p. 15, 1907.

I have accomplished the same result in several cases in subsequent cultures of these forms. But I find from this summer's cultures that this type differs constantly from the *O. lata* of de Vries, as the latter appears in cultures or as a mutant from *O. Lamarckiana*. In bud characters it resembles *O. semilata*, but the leaf characters are closer to those of *lata* than to *semilata*. Hence while agreeing with the *lata* mutant in most of its characters, it differs constantly from the *lata* which is a derivative of the Amsterdam cultures, in its ability to produce a considerable amount of viable pollen, as well as in the (probably correlated) shape of its buds.

The frequent association in various genera, of apogamous conditions with the failure to produce pollen, led me to consider the possibility that *O. lata* might show a similar condition. This surmise has since been strengthened by certain facts recorded by Miss Lutz.² She found certain *O. lata* plants having the *lata* number of chromosomes, in the first generation of hybrids from *O. lata* × *O. gigas*. I have referred to this in a recent publication³ and suggested that the most probable explanation is that they originated apogamously. The facts are these. In a total of about forty plants from the F₁ of *O. lata* × *O. gigas* Miss Lutz found (I.) two plants which were identical with *O. lata* in every respect and had fifteen chromosomes; (II.) six plants which were very similar to *O. gigas*, having about thirty chromosomes so far as counts were made; and (III.) thirty-two plants which, though not clearly characterized in the description, seem to have been in part intermediate between *O. lata* and *O. gigas*, and in part intermediate between *O. Lamarckiana* and *O. gigas*. A portion of these latter plants are stated to have twenty-two somatic chromosomes, "others twenty-three and some possibly

²"Notes on the First Generation Hybrid of *Oenothera lata* × *O. gigas*," *SCIENCE*, 29: 263-267, 1909.

³"The Behavior of the Chromosomes in *Oenothera lata* × *O. gigas*," *Bot. Gaz.*, 48: 179-199, pls. 12-14, 1909. This paper deals with the chromosome behavior in the germ cells of hybrids having 20 and 21 chromosomes.

twenty-one chromosomes." Whether these hybrids all had the same individual *O. lata* plant as mother is not stated, but if this was the case and the mother had fifteen chromosomes, then we might expect the two *lata* plants in the offspring both to have fifteen chromosomes, and the hybrids of class III. to have twenty-one or twenty-two chromosomes (14 + 7 or 14 + 8), while in the case of the *O. gigas*-like plants which are stated to have had thirty chromosomes in the individuals in which a count was made, the expectation would perhaps be twenty-nine (15 + 14).

How the *O. gigas*-like individuals having about thirty chromosomes originated must, however, be a matter of conjecture at the present time.

Miss Lutz calls the *O. lata* plants in this cross "extracted latas," which would indicate their hybrid origin. But in view of the fact that they have the *lata* number of chromosomes (14 or 15) and in view also of the subsequent data which I am about to state, it seems highly probable that they originated apogamously from the *O. lata* parent.

De Vries⁴ made the cross *O. lata* × *O. gigas* in 1905 and grew one hundred and thirty-three of the offspring in 1907 and a smaller number in 1908. Of the former number sixty-eight were found to be intermediate between *O. lata* and *O. gigas*, and sixty-five intermediate between *O. Lamarckiana* and *O. gigas*, and the 1908 culture repeated the same two types, also in about equal proportions. From this it appears that there were no pure *O. lata* individuals and hence could have been no apogamy in these cultures at Amsterdam.

The peculiarities of *O. lata* are such that there need be no difficulty in distinguishing it from *O. Lamarckiana* or *O. gigas* or even from forms intermediate between *O. lata* and *O. gigas*. The further fact that Miss Lutz found the two *lata* individuals in her cross to have fifteen chromosomes, supports the belief in their apogamous origin.

In my experiments this summer, to determine more definitely the occurrence of apogamy in *O. lata*, I removed the anthers (which

⁴"Bastarde von *Oenothera gigas*," *Ber. Deutsch. Bot. Gesells.*, 26a: 754-762, 1908.

were always dry and empty) from several flowers of an individual of *O. lata*, at the same time removing the stigma and style by pulling the latter out at the base as an extra precaution, afterwards covering the flower with a bag and marking the capsule according to the method I ordinarily use in making guarded crosses. All of the flowers so treated but one gave negative results, but this one produced three fair-sized seeds.

Ordinarily, if, for some reason, a flower fails to be pollinated, the ovules remain very small and gradually dry up and wither, so that after a few weeks such an ovary has not grown in size and if broken open shows numerous small, dried granules which are the remnants of the deteriorated ovules, many of them still attached in their original position. These three seeds, while slightly below the average in size, yet were hundreds of times larger than the small remnants of such unfertilized ovules, and indeed there were many of the latter in the capsule in question, in addition to the three seeds.

In every case where pollination was thus prevented, the ovary remained very small and gradually dried up and shrank to a small diameter, and the one containing the seeds was but little larger than the rest. Several of these small dry ovaries fell off and hence were never examined for seeds. The number of seeds, if there were any present, could not have been large in any of them.

I also treated, in a similar manner, a number of flowers from several individuals of the English *O. lata*, which produces some pollen; but without exception the results were negative.

In this connection will be recalled the discovery of Ostenfeld⁵ and Rosenberg⁶ that certain species of *Hieracium* are partly apogamous or aposporous, and partly require fertilization. But in this genus of Composites, where each flower of a head develops a single seed which is independent of all the other seeds

⁵ "Castration and Hybridization Experiments with some Species of *Hieracia*," *Bot. Tidsskrift*, 27: 225-248, 1906.

⁶ "Cytological Studies on the Apogamy in *Hieracium*," *Bot. Tidsskrift*, 28: 143-170, 1907.

of a head, the conditions of nutrition are much more favorable to partial apogamy when pollen is excluded from the head, than is the case in an *Oenothera* capsule where the ovules are closely crowded together into four chambers and the deterioration of the great majority of them in the absence of fertilization is likely to carry down the others in the common ruin and also to lead to the cutting off of the common food supply.

So far as I am aware, the only other indication of the development of embryos in *Oenothera* without previous fertilization is in *O. gigas*. Schouten⁷ reports obtaining one *O. laevifolia* individual in a large culture of *O. gigas*. Now I have found that *O. laevifolia* has fourteen chromosomes, while *O. gigas* is known to have twenty-eight.⁸ Such an individual of *O. laevifolia* might have arisen from *O. gigas* through a process of parthenogenesis in the restricted sense of Strasburger,⁹ an egg with the reduced number of chromosomes producing the embryo without fertilization. At present no case of this sort is known in the plant kingdom, although in echinoderms and various other animals the artificial production of larvæ from unfertilized eggs is a well-known fact and, in some of these cases at least, the number of chromosomes is the reduced number. Whether the origin of this *O. laevifolia* individual was of a similar sort must remain for the present undecided. The fact that in such plant genera as *Alchemilla* and *Hieracium* the apogamous members of the genus frequently have about twice as many chromosomes as the normally fertilized members would make the occurrence of similar conditions in *O. gigas* a thing which might reasonably be anticipated.

This indication of apogamy in *O. lata* of

⁷ "Mutabiliteit en variabiliteit," p. 93, dissertation, Groningen, 1908.

⁸ In all these forms there are probably occasional departures of one or more chromosomes from the usual number, owing to the occasional irregularities in chromosome distribution which I have shown (*Bot. Gaz.*, 46: 1-34) to occur in the formation of the germ cells.

⁹ "Apogamie bei Marsilia," *Flora*, 97: 163, 1907.

course requires to be substantiated by a more detailed study and I am making a cytological investigation of the embryo sac development and fertilization in *O. lata* with the hope of obtaining more conclusive evidence of the presence of some form of apogamy in this mutant.

R. R. GATES

MISSOURI BOTANICAL GARDEN,
September 29, 1909

MEMBRANE FORMATION AND PIGMENT MIGRATION
IN SEA URCHIN EGGS AS BEARING ON THE
PROBLEM OF ARTIFICIAL
PARTHENOGENESIS

IN a recent number of *SCIENCE* McClendon¹ has summarized his work on artificial parthenogenesis in *Arbacia* and discussed it with reference to changes in permeability of the surface layer of the egg. With the same point in view, during June and July at Tortugas and the latter part of August, 1909, at Woods Hole, I have been studying the earliest changes taking place in developing sea urchin eggs, especially the formation of the fertilization membrane.

Ever since the paper of Delage appeared, on electric parthenogenesis, I have been impressed with the great similarity in the means of stimulating eggs to develop and the means of stimulating muscles and sensitive plants. Morgan expressed the situation clearly when he compared the means of causing development to a stimulus. A considerable mass of evidence now exists, especially emphasized in recent papers of Ralph Lillie, that stimulation of muscles is effected by a momentary increase in permeability of the muscle membrane to CO_2 , allowing its more ready escape during contraction. CO_2 is the chief end product of the energy-yielding reaction on which contraction depends and its removal from the cells allows the reaction to proceed (during contraction) to a new equilibrium (of rest), when checked by a second accumulation of CO_2 . The increase of permeability on stimulation removes the condition which is preventing the contraction. The move-

ments of sensitive plants can best be explained as due to an increase in permeability of the cell membranes relative to the turgor-maintaining substances. The important point is that processes in general brought about by stimulation are connected with changes in permeability. This holds good for secretion, and the fact that the first visible change in many eggs is a secretion is certainly significant.

Several authors have recorded instances of development without membranes, perhaps the best known case being parthenogenesis by hypertonic sea water. I have repeated this experiment and find that there is without doubt a surface change in the egg, visible on slightly high focus, which I take to be a membrane very close to the egg surface. Similar membranes are produced in *Hippangoë* eggs by treatment with CH_3COOH . They are hardly noticeable even with the high power. Very close fitting membranes and membranes which surround each blastomere when the egg divides may be produced in other ways. It seems as if development without membranes was rather a case of development without pushing out of the membrane.

This pushing out appears to be due to the formation of some substance exerting an osmotic pressure between it and the cell surface, which absorbs the surrounding sea-water. It would be impossible for the fluid between fertilization membrane and egg to have come from the egg without a greater diminution in volume than is observed in eggs immediately after fertilization. Loeb² has discussed the above view and designated a proteid or lipid as the substance in question. A very small concentration of some substance formed just behind the fertilization membrane would account for its pushing out, provided the membrane were impermeable to the substance and freely permeable to the salts of sea-water. For the latter there is ample evidence.

The membrane itself is a secretion comparable to the cellulose layers formed on plant cells after division. It is composed of some substance of a highly resistant nature

¹ N. S., XXX., p. 454, October 1, 1909.

² Arch. Entw. Mech., XXVI., 1908, p. 82.

as is shown both by its insolubility in concentrated mineral acids, including sulphuric, and also on short boiling in molecular solutions of caustic alkalis. On prolonged boiling it either dissolves or becomes so broken up as to be unrecognizable. The egg itself dissolves entirely in concentrated H_2SO_4 and in NaOH except for a few granules. Unfertilized eggs dissolve entirely in concentrated H_2SO_4 , showing that the membrane is not present before fertilization. It is also left undigested by pepsin HCl.

Regarding the membrane as a secretion, its formation is strong evidence that an increase of permeability, of which it is the direct result, is brought about by the various membrane-forming substances. Its removal from the sphere of reacting substances (in the egg) must upset any chemical equilibrium which has been attained, this equilibrium meaning a condition of rest and non-development of the egg.

The second visible change occurring in some sea-urchin eggs, *e. g.*, *Arbacia*, is the migration of the red pigment granules, which, until after formation of the fertilization membrane are distributed throughout the cytoplasm, to the periphery of the egg, as mentioned by McClendon. This migration can be explained on the assumption that the change of permeability associated with membrane formation is connected with ionic interchange between exterior and interior of the cell giving rise to potential differences such as are seen in the functioning of glands, muscles, nerves and sensitive plants. Lillie³ has discussed this, theoretically, in a paper in which an increase in permeability is also taken to be the change bringing about development. "With the appearance of an increased permeability . . ., the peripheral regions of the protoplasm must become, for a time at least, until the potentials are equalized, *positive* relative to the interior." Most small particles suspended in a fluid become negatively charged and migrate in an electric field. The fact that these bodies are repelled by the asters is further evidence for regarding them as nega-

tive, for Lillie has suggested several reasons which point to the asters as regions of negative charge. It is on account of the prominent asters present at this stage that the micromeres are free of pigment. Even when cut off from the pigmented area of centrifuged eggs these cells are relatively free from pigment granules.

Such small electro-negative particles, in equilibrium under conditions of rest in the cell, would, on an increase of permeability, migrate toward the now positive cell surface. A calculation (by Lillie) of the potential difference which might arise, based on the observed changes in muscle cells, gives a value of 14 volts per cm., which would be ample to account for the changes observed in *Arbacia*. This same movement occurs in eggs treated with hypertonic sea-water and CH_3COOH .

This change in potential must be accompanied by an increase in surface tension (see Lillie) and it is quite generally true that the surface tension increases immediately after fertilization, as indicated by the rounding up of eggs which were previously oval or elongated in shape.

The facts which indicate an increase in permeability of the surface membrane as the first change taking place in the development of an egg may be summarized as follows:

1. The general similarity in the means of stimulating eggs to divide and the means of stimulating muscles and sensitive plants. These may be broadly classified as chemical, mechanical, electrical, thermal and osmotic.
2. The fact that the chemical substances which start parthenogenesis cause in other cells an increase in permeability (hæmolysis of red blood corpuscles and loss of pigment in pigment-bearing cells).
3. Evidence that stronger concentrations of development-starting substances cause loss of pigment in pigmented eggs.
4. That a secretion is the first visible change occurring in many eggs.
5. That a migration of pigment-containing granules to the cell surface in *Arbacia* eggs is caused by a region of positive charge at the surface resulting from ionic interchange ac-

³ *Biol. Bull.*, XVII., p. 207, 1909.

companying increased permeability after membrane formation.

6. That an increase of surface tension, which must accompany a change of potential at the surface, is quite general in naked eggs after fertilization, as indicated by their rounding up when previously they had been irregular in outline.

A logical explanation is afforded why such a change as increased permeability should cause development, namely—the removal of some reaction product whose accumulation has brought the cycle of reactions occurring during the growth period to a standstill. This does not exclude the possibility that in time another change may take place which leads to those disintegrative changes, especially emphasized by Loeb.

E. NEWTON HARVEY

COLUMBIA UNIVERSITY,
October 7, 1909

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 668th meeting was held on October 9, 1909, Acting President Wead presiding. The following papers were read:

Reversion of Power Series: C. E. VAN ORSTRAND, of the Carnegie Institution of Washington.

The equation which Professors Harkness and Morley developed for the reversion of a power series was extended so as to obtain a general term for the reverse series similar to the one obtained by Professor McMahon. The complete expansion for the first thirteen coefficients was given, and some comment was made in regard to the application of the reverse series to inverse functions including solutions of polynomials of the n -th degree.

The Vibration Galvanometer: FRANK WENNER, of the Bureau of Standards.

The vibration galvanometer is an instrument for the detection or comparison of small alternating currents and electromotive forces. It differs from other instruments for the same purpose mainly in having the moving system tuned to the frequency of the current or electromotive force to be investigated.

The general theory of the instrument was developed, and equations derived which show how the amplitude of the vibration depends upon the

various constants of the instrument and the conditions under which it is used. An auxiliary set of equations gives all the constants in terms of quantities easily measured. This makes it possible, with but few simple measurements on any particular instrument, to predict its behavior under almost any set of conditions, or to calculate the effect of any contemplated change in the design.

It has been observed that some instruments resonate to two different frequencies. The cause of this double period of the moving system was explained. For those instruments which develop a relatively large back electromotive force the effect of putting a large inductance in the circuit is shown and the advantage of using a step-up transformer is pointed out.

The experimental part of the work has to do mainly with the verification of the more important relations shown by the equations. The constants of the different instruments used were obtained, using the theory developed. Some of the constants are also determined by an independent method and thus serve as checks on the theory. A method of tuning was given which is more sensitive than the method generally used and which is applicable in other cases where the vibration is forced.

W. P. White, of the Carnegie Institution of Washington, spoke informally on the zero shift in moving-coil galvanometers, discussing briefly its cause and how it may be lessened.

R. L. FARIS,
Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

THE 192d meeting of the Washington Section of the American Chemical Society was held at the George Washington University Lecture Hall on October 14, 1909. President Walker presided, the attendance being 94. Dr. H. W. Wiley gave a report of the seventh International Congress of Applied Chemistry, held in London in May and June of this year, including a history of the development of the society. He described the entertainments furnished by the British members, told of the more important papers presented at the meeting and of the personnel in attendance, and the part taken by some of the prominent American chemists. Twenty-one new names were added to the list of members and twelve names removed.

J. A. LECLERC,
Secretary